SOCIO-ECONOMIC SURVEY
OF
SMALLHOLDER FARMING SYSTEMS IN SOLOMON ISLANDS

MARAU SOUND
GUADALCANAL PROVINCE

Agricultural Economics Section
Rural Services Project
Ministry of Agriculture and Lands
Solomon Islands

April 1989

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Abbreviations and Units of Measure

AES	Agricultural Economics Section (RSP)
CEMA	Commodities Exporting and Marketing Authority
DCRS	Dodo Creek Research Station
MAL	Ministry of Agriculture and Lands
PBME	Project Beneficiary Monitoring and Evaluation (RSP)
RDC	Rural Development Centre (RSP)
RSP	Rural Services Project
km	kilometre = 1,000 m
ha	hectare = 10,000 sq m
m	metre
MT	metric tonne = 1,000 kg
SI$	Solomon Islands Dollar

Acknowledgements

The present report is produced by the staff of the Agricultural Economics Section. The Section was established under the ADB/IDA/IFAD assisted Rural Services Project and is engaged in a two years socio-economic study of smallholder farming systems throughout Solomon Islands, extending from 1987 to 1989.

Many others contributed to the planning of the programme and in its implementation. The study would not have been possible without the support and patience of local people. To them we are grateful and hope that the present report will be in some way of benefit.

We would like to thank members of the Ministry of Agriculture and Lands, in particular the Director of the Rural Services Project and staff, and the Chief Research Officer and staff for their support throughout.

The Statistics Office of the Ministry of Finance has assisted the survey through the generous lending of equipment, canoes and outboards, and in sampling. Thanks are especially due to Richard Harris, Rural Statistician, for his interest in the survey from the outset.

Not least, thanks are extended to the Premier of Guadalcanal Province, the Provincial Secretary and staff, the Principal Field Officer and members of the agricultural extension service for their support in establishing the survey. It is especially hoped that the present report will find a practical application in development works being undertaken in the Province.

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Solomon Islands

Chapter: 1
INTRODUCTION

1.1 The Solomon Islands comprise a double chain of islands extending in a north-west south-east direction over 860km of the south-west Pacific between latitudes 5°-12°S and longitudes 155°-170°E. The islands lie directly along a major line of crustal weakness traversing the western Pacific and are the surface expressions of fault-bounded blocks and troughs originating in a zone of geologically intense activity. Warping and block movement are the most significant geomorphic processes responsible for the elevation of land to its present altitude, with marine sediments occuring on some of the highest ranges. Such processes continue spasmodically and raised reefs at various heights occur in many parts of the country, as does intense faulting. Earthquakes are frequent and often initiate land movements in ground already close to shearing point such as saturated soil at the heads of steeply incised gullies, resulting in debris slides among the high ridges (10).

1.2 Solomon Islands lies well within the geographical tropics in an oceanic area where two contrasting trade winds meet, a low-pressure belt of ascending air known as the "inter-tropical convergence zone" (ITCZ). In this zone warm and humid air masses drawn from equatorial regions meet relatively cool and dry sub-tropical air derived from the south-east. From about March to November the islands experience steady, shallow, south-easterly winds. During November and December unsettled weather is likely as the ITCZ moves south over the islands, from which follows steady north-westerly winds. March and April are again unsettled as the ITCZ returns northwards until the south-easterly trade winds become re-established. Cyclonic disturbances may be generated, particularly around December and April when the convergence of the two air streams is strongest. Weather is varied, both temporally and spatially, but is characterised by continally high average temperatures and humitity. Most land areas have a mean annual rainfall of 3,000-5,000mm with variations depending on latitude and orientation to prevailing winds. Temperatures are more uniform, at around 26°C in the lowlands, and never reach extremes which would restrict plant growth. Night time humidity exceeds 90%. This may fall to 60% on clear sunny days, or remain close to saturation point during cyclonic conditions (10).

1.3 The islands are rugged, with a predominance of ridge-valley landscapes and high relief. Undulating rolling landscapes have a limited distribution and extensive fluvial plains are uncommon. Chemical weathering is intense under conditions of continuously high temperature and moisture, however, soil depths are not generally great. Most hill areas have slopes exceeding 12-15° and commonly reach 35-55° among the mountain ridges. Continual soil wash and creep and periodic mass movements effectively keep pace with rock weathering. Only on stable flatter sites do deep profiles develop. The islands for the most part are covered in dense forest, some fire disclimax grassland in parts of Guadalcanal and Florida Islands, and land cleared or cultivated(10).

1.4 The population of Solomon Islands from the 1986 census was 285,176, with an annual growth rate of 3.5%. The land area of 28,370sq km gives a low overall population density of 10 persons per sq km. Settlements are mostly along the coastal margins so that in some parts of the country population densities are high.

1.5 The population distribution of Solomon Islands is summarised in diagram 1.1 and key socio-economic data is presented in table 1.1.

1.6 There is considerable variation between land area and population among the provinces. While Western Province accounts for 33% of the national land area it contains only 19% of the population. The West is characterised by low population density compared to provinces such as Central, Malaita and Temotu. Although Temotu contains 5% of the national population it also accounts for only 3% of the national land area, and therefore has a relatively high mean population density. Land area in Solomon Islands is summarised in diagram 1.2.

1.7 While a provincial comparison presents a broad indication of population densities throughout the country, differences within provinces are of significance to agricultural policy. With improvements in communications and administrative links there has been a general migration to the coastal margins where travel and marketing are easier, and where services such as schooling and health are more readily available. The highland interior tends to be sparsely populated in comparison.

Table: 1.1
SOLOMON ISLANDS KEY DATA

Province	Western	Ysabel	Central	Guadalcanal	Honiara
POPULATION					
1986 population	55,250	14,616	18,457	49,831	30,413
annual growth rate	3.0	3.2	2.9	4.3	6.8
% national population	19	5	6	17	11
peri-urban population	3,710	1,901	1,622		30,413
% peri-urban	7	13	9	38	
number of households	7,942	2,362	3,079	8,072	4,317
LAND AREA					
land area (sq km)	9,312	4,136	1,286	5,336	22
% land area	33	15	5	19	0
population density/sq km	6	4	14	9	1,382
1987 PROVINCIAL GOVERNMENT REVENUE AND EXPENDITURE (SI$'000)					
revenue	443	173	191	281	1,033
grants	2,556	634	623	1,247	704
current expenditure	3,504	849	750	1,431	1,561
capital expenditure	200	58	88	192	177
net revenue (negative)	(705)	(100)	(24)	(96)	(2)

Province	Malaita	Makira	Temotu	Total
POPULATION				
1986 population	80,032	21,796	14,781	285,176
annual growth rate	2.7	3.6	2.8	3.5
% national population	28	8	5	100
peri-urban population	3,252	2,588	1,295	44,781
% peri-urban	4	12	9	16
number of households	12,417	3,278	2,375	43,842
LAND AREA				
land area (sq km)	4,225	3,188	865	28,370
% land area	15	11	3	100
population density/sq km	19	7	17	10
1987 PROVINCIAL GOVERNMENT REVENUE AND EXPENDITURE (SI$'000)				
revenue	339	485	160	3,103
grants	1,891	1,095	445	9,195
current expenditure	2,190	1,472	615	12,371
capital expenditure	331	600	0	1,646
net revenue (negative)	(291)	(492)	(10)	(1,719)

Source: Statistics Office Statistical Bulletin 15/87 "Provincial Statistics"
Populationa data revised from Statistics Office Statistical Bulletin 3/88 "Solomon Islands Population Census"

POPULATION COMPOSITION

% by province

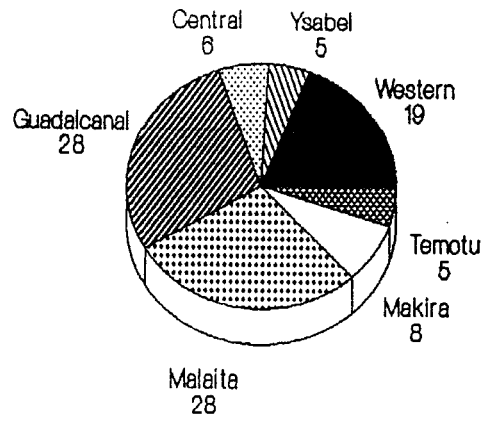


Diagram: 1.1

LAND AREA

% by province

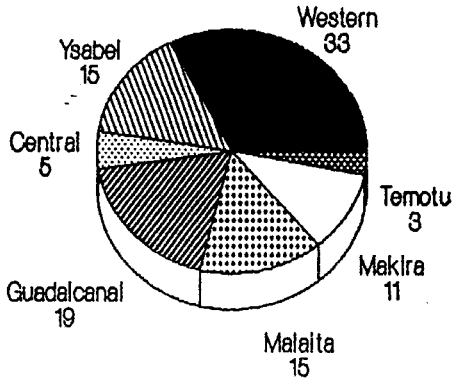


Diagram: 1.2

1.8 Although overall population density is low, in some areas a growing population pressure is causing concern. Traditional farming systems based on forest fallow may be sustained under conditions of low pressure, but run into soil fertility and related problems when fallow periods are reduced and cropping intensified. Conversely, there are sparsely populated areas of agricultural potential where communications and services are poorly developed. The Rural Services Project is developing facilities in areas of high agricultural potential, providing marketing and transport infrastructure, agricultural and training services, and extending the coverage of adaptive research. These provide new opportunities for agricultural development.

1.9 The capacity of government to implement development programmes is to a large extent determined by funds and resources available. Diagram 1.3 summarises provincial government revenue and expenditure in 1987. Nationally there was a deficit of SI$1.7 million arising through over expenditure in all provinces. Provincial finance is characterised by a low revenue earning capacity, being nationally about one third of the level of central government grants. Revenue and grants are expended almost entirely on basic operating costs, although these remain severely constrained and under-funded. There are little or no funds for development, and investment amounted to only 12% of total expenditure in 1987.

1.10 Agriculture accounted for 42% of export earnings in 1985 [11], although this has dropped from the much higher level of 87% in 1960. It is the major employment activity in the country and the source of livelihood for the majority of the population. In terms of human welfare and economic development, agriculture remains high among national priorities.

1.11 Despite various studies undertaken in the past, there is little hard socio-economic data on smallholder farming systems which would assist agricultural policy makers, trainers, extension workers and researchers in the planning, implementation and evaluation of development activities. A national sample survey of agriculture was conducted in 1974-75 [5], but these data are are no longer able to satisfy information requirements.

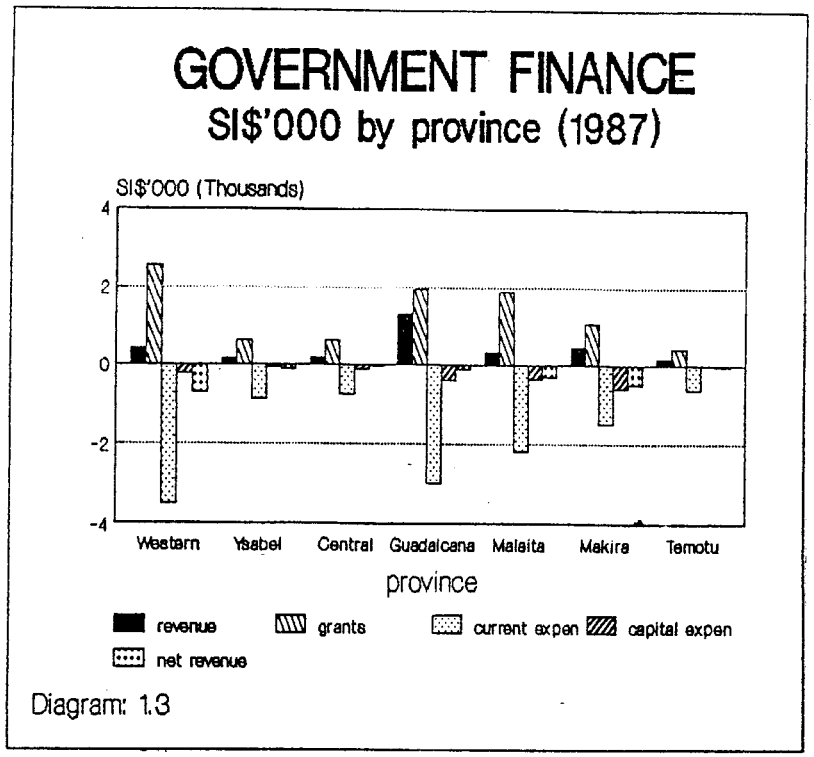


Diagram: 1.3

1.12 The Agricultural Economics Section (AES) was established under the Rural Services Project (RSP) inter alia in order to generate statistical information on smallholder production systems for the quantification of constraints to agricultural development and the devising of appropriate agricultural research programmes. The present study is part of a national survey programme to generate detailed base-line data on smallholder farming systems.

1.13 Since September 1987 AES has conducted a series of farming systems surveys in selected sites throughout the country, such as in the immediate areas of influence of Rural Development Centres or in other areas of special agricultural interest. It is intended that the findings of the survey will find application in the evaluation of development activities, and will assist in the assessment of changes taking place in Solomon Islands agriculture and the formulation of development strategies. The background and justification for the survey programme are documented in the AES Inception Report of 1987 [20]. Methodologies are described in the Agricultural Economics Field Survey Manual [21] and related documents produced by AES.

1.14 The Marau Sound survey was conducted in November and December 1987 and covered a sample of 40 rural households within the immediate area of influence of the Rural Development Centre. Two stage systematic random sampling was guided by the Statistics Office based on equal probability of household selection, with accessibility taken into account in the definition of the sample frame. Villages were listed from the 1986 population census, and selected by systematic random sampling. A pre-determined number of households within each village (or cluster of small villages) were then selected by simple random sampling. Maps of the survey area are presented in diagrams 1.4 and 1.5.

1.15 The survey is designed to investigate the structure and dynamics of smallholder crop and management systems. Of particular importance in the socio-economics of smallholder agriculture is the allocation of labour, since few cash inputs are applied and little wage labour is employed.

1.16 All cultivated areas, including cropped and cleared land, are measured by tape and compass to an error tolerance of 5%. Crop areas are computed and checked in the field by programmable calculator. Data are processed in "dBASE III Plus" databases and analysed through "SPSS/PC+". Raw output is transferred to "Lotus 123 vr 2" spreadsheets for tabulation and secondary processing. Text tables are incorporated into "Wordstar Professional r 4" and graphics are edited in "Harvard Presentation Graphics".

1.17 Data processing and the presentation of results has been made possible by the generosity of the Government of New Zealand through its Miscellaneous Technical Assistance Programme. This has overcome a primary constraint to work of this kind in the Ministry of Agriculture and Lands through the provision of computing hardware.

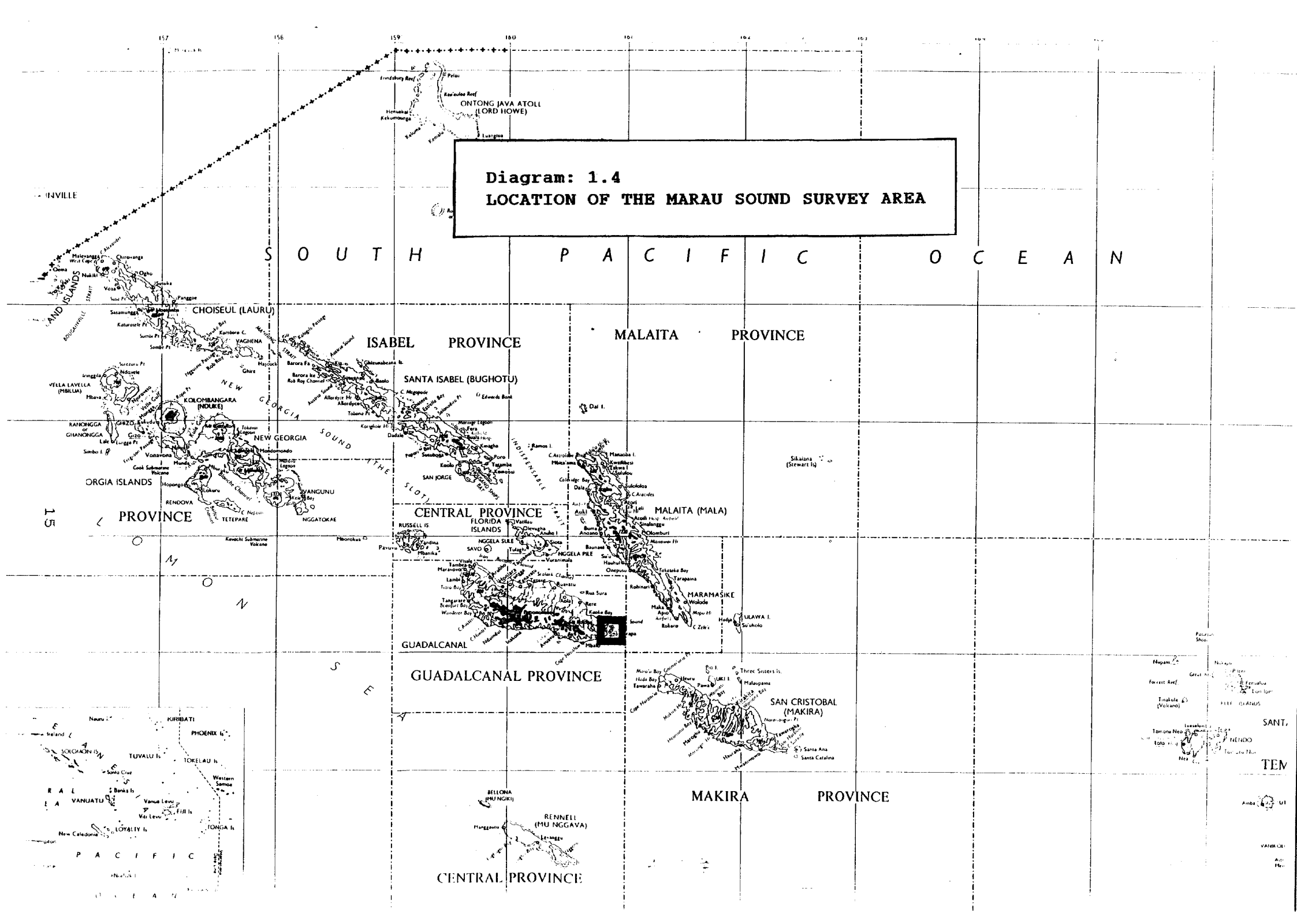


Diagram: 1.4
LOCATION OF THE MARAU SOUND SURVEY AREA
SOUTH PACIFIC OCEAN
ONTONG JAVA ATOLL (LORD HOWE)
CHOISEUL (LAURU)
ISABEL PROVINCE
MALAITA PROVINCE
SANTA ISABEL (BUGHOTU)
NEW GEORGIA
NEW GEORGIA SOUND
KOLOMBANGARA (NDUKE)
VELLA LAVELLA (MBILUA)
RANONGGA or GHANONGGA
GIZO
VONAVONA
RENDOVA
TETEPARE
NGGATOKAE
ORGIA ISLANDS
PROVINCE
CENTRAL PROVINCE
FLORIDA ISLANDS
RUSSELL IS.
SAVO
NGGELA SULE
NGGELA PILE
MALAITA (MALA)
MARAMASIKE
ULAWA I.
GUADALCANAL
GUADALCANAL PROVINCE
SAN CRISTOBAL (MAKIRA)
MAKIRA PROVINCE
RENNELL (MU NGGAVA)
BELLONA (MUNGIKI)
CENTRAL PROVINCE
SOLOMON SEA
KIRIBATI
PHOENIX Is.
TUVALU Is.
TOKELAU Is.
Western Samoa
VANUATU
Banks Is.
Vanua Levu
Viti Levu
FIJI Is.
LOYALTY Is.
TONGA Is.
New Caledonia
PACIFIC

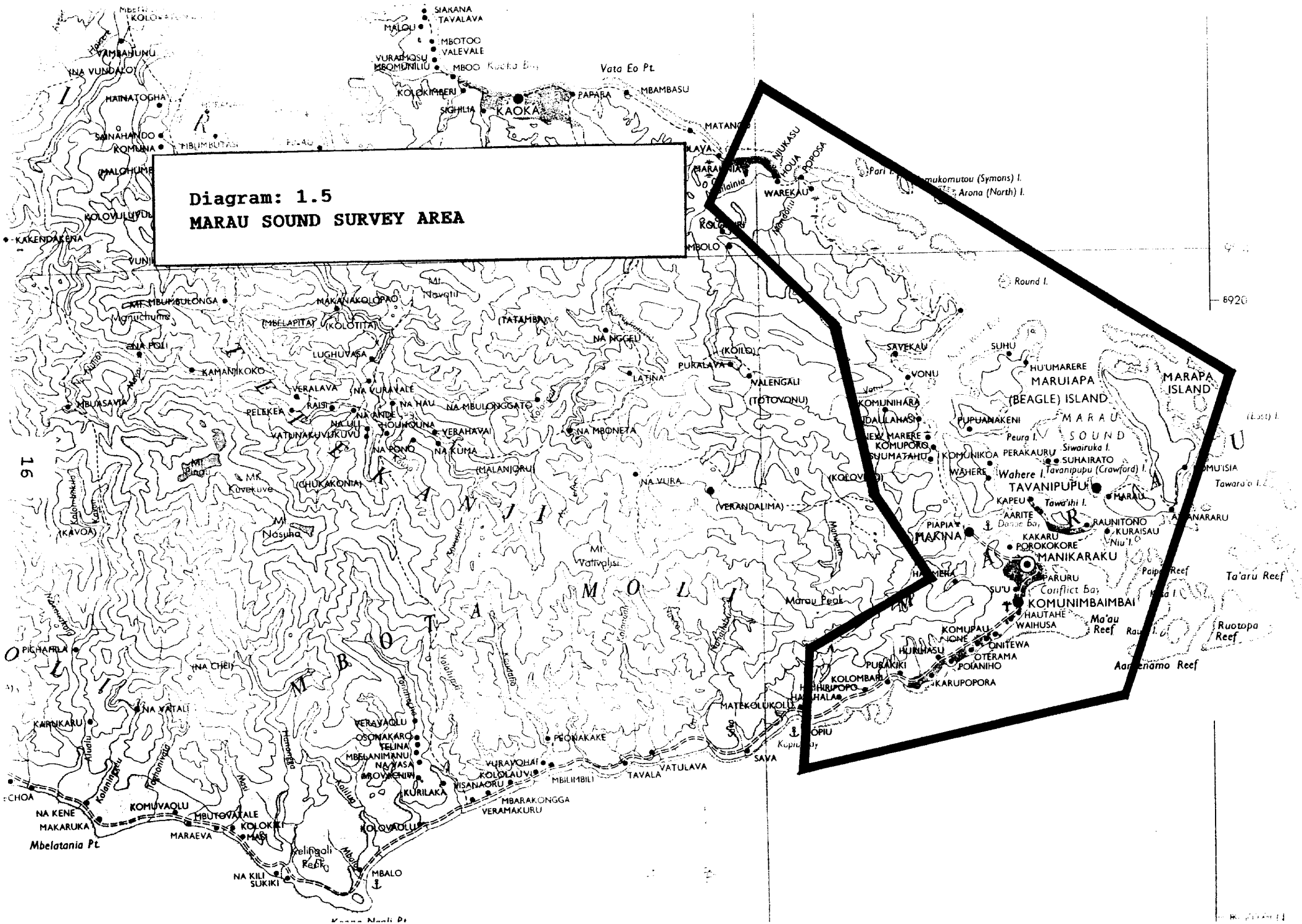


Diagram: 1.5
MARAU SOUND SURVEY AREA
MARAU SOUND
MARUIAPA (BEAGLE) ISLAND
MARAPA ISLAND
TAVANIPUPU
MANIKARAKU
KOMUNIMBAIMBAI
KAOKA
MAKINA
Wahere I.
Siwairuka I.
Tawa'ihi I.
Round I.
Marau Peak
Conflict Bay
Ta'aru Reef
Ma'au Reef
Ruotopa Reef
Mbelatania Pt
Vata Eo Pt
6920
16

Chapter: 2
SUMMARY AND MAIN FINDINGS

Household Composition

2.1 The mean household size in the survey area is 7.00, comprised of 3.10 males and 3.90 females. The imbalance, with a gender ratio of 1:1.26 males to females is reflected in a net onward movement of males, predominantly in the economically active age group.

2.2 The available labour composition of rural households in the survey area is **1.83male:2.31female**, or **56%** female of **4.14** adult equivalent labour units per household.

Income Earning Activities

2.3 Rural income earning activities in terms of frequency of activity, but not necessarily income contribution, are predominantly "food crop" sales. **35%** of households are engaged in food crop marketing compared with **10%** of households in the marketing of copra and **5%** cocoa. Fishing is important, with **28%** of households earning income from the sale of fish, and **13%** from the sale of shellfish.

2.4 The rural economy is diverse, with a wide range of income earning opportunities. **23%** of households are engaged in some form of business enterprise. **18%** are members of production or marketing cooperatives, and **8%** have a skilled trade or profession. No logging or mining activities are conducted by households in the survey.

Extension and Mass Media

2.5 **67%** of households listen to agricultural programmes on the radio, although only **28%** listen regularly. Written materials may be more appropriate extension media than has been supposed since it is found that **95%** of households have at least one member with some reading and writing ability. The survey does not, however, verify this result or investigate the quality of such skills.

2.6 Given severe funding and other constraints experienced, it is unsurprising that the intensity of extension services is low. 63% of households have never been visited by extension workers, whether government or non-government, and there are few cases of regular visits. Little use appears to be made of simple extension methods such as village meetings. There is no evidence of extension bias but neither is there evidence of programme targeting.

Livestock

2.7 Livestock, predominantly pigs and chickens, are an important component of smallholder farming systems. 63% of households own pigs with a mean herd size of 4.88 among owners. Chickens are kept by 58% of households, with a mean flock size of 12.65 among owners. Ducks are owned by 10% of households with a mean flock size of 7.25 among owners.

2.8 Cattle, introduced under former but now discontinued community projects, are held by 8% of farmers, with a herd size of 7.0 among owners.

2.9 There is no occurence of novel livestock enterprises such as bee keeping, butterfly or crocodile farming among sampled farmers.

Holding Size Distribution

2.10 The mean holding size, in terms of area cultivated is 1.169ha but the holding size distribution is skewed. 59% of farmers have holdings of less than 0.5ha and over 74% of farmers have holdings less than the mean size of 1.169ha. The median holding size of 0.360ha indicates that inequalities in the size of holdings should be taken into account in development programmes, since the mean in itself is liable to be misleading.

2.11 Inequality in holding size can to a large extent be explained by whether or not farmers have tree crops, notably coconuts. Such holdings tend to be large, with a mean size of 2.427ha but they represent only 41% of farmers. Conversely non-tree cropping farmers have a mean holding size of 0.294ha and represent 59% of sampled farmers.

2.12 **97%** of farmers grow traditional subsistence or food crops, where the area cultivated to these crops is relatively constant among all farmers. The overall mean food crop area is **0.318ha** and the mean tree crop area is **2.093ha**.

Labour Density

2.13 The mean labour availability among 39 households is **4.21** adult equivalent labour units per household, resulting in a mean labour density of **3.60** labour units per hectare. There is no apparent relationship between labour availability and holding size. Consequently labour density per unit area falls rapidly from **22.01** labour units per hectare on holdings of less than 0.25ha in size to **0.28** labour units per hectare on holdings greater than 10ha in size. On non-tree cropping holdings the mean labour density is **13.29** labour units per hectare compared with **1.92** labour units per hectare on tree-crop holdings. This suggests that labour is unlikely to be limiting on the majority of small holdings, but may be on larger holdings and in particular on tree crops.

Cropping Patterns

2.14 The average holding size is **1.17ha**, however, a distinction is made between farmers with tree crops and those with no tree crops. Of households with tree crops the mean holding size is **2.42ha**, of which **2.09ha** is under tree crops and **0.33ha** is food crops. In contrast non-tree crop farmers have a mean holding size of **0.29ha** comprised of **0.02ha** short term cash crops and **0.27ha** food crops. Smallholder cropping patterns are complex and diverse, with **13** dominant crops recorded and a total of **55** distinct mixtures.

Coconuts and Cocoa

2.15 **41%** of households have coconuts and **8%** also have cocoa[30].

2.16 Almost all coconuts are local tall. **17%** are less than 8 years of age, **23%** are aged 9 - 16 years, and **58%** are aged 17 - 40 years. Only **3%** are over 40 years of age.

2.17 **4%** of coconut plantings are undercropped with food crops in new stands, **29%** are brushed to ground level, **42%** are brushed to shoulder height and **25%** have reverted to secondary bush.

Fallow

2.18 Fallow in Solomon Islands farming systems is necessary for the maintenance of soil fertility, predominantly in the replenishment of potassium in ash following burning. Shifting cultivation has other valuable characteristics, not least its phytosanitary qualities. The fallow period is an indicator of land pressure, and possible fertility and pest problems associated with intensive cultivation. On gardens where it is known, there is a fallow period of **5.6** years, but **50%** of gardens have a fallow longer than memory. Root crops are typically grown for 1 to 3 years depending on the crop, with 3 to 4 harvests, and then abandodned for 5 years or more.

2.19 **67%** of all gardens have a fallow of primary or secondary forest, with a further **20%** under dense shrubby thicket. Such long fallow regeneration is found over **77%** of the cropped area. Present fallow periods are able to maintain productivity in smallholder farming systems under the present low pressure of population, but such extensive land use may not be sustainable in the longer term.

2.20 **8%** of the food garden area was cut from primary forest compared with **45%** of the tree crop area. Overall **36%** of the cultivated area has expanded into primary forest with encroachment especially from cash cropping.

Landform

2.21 **78%** of coconut gardens representing **83%** of coconut area are on beach sites or lowland plains. **22%** of coconut gardens representing **17%** of the coconut area are on upland sites, on slopes of varying steepness but some on very steep sites.

2.22 In contrast the majority of food crop gardens are on upland sites. **57%** of food crop gardens representing **61%** of the food garden area are on upland, mostly steeply sloping, sites. **43%** of gardens representing **39%** of the food garden area are on lowland plains.

2.23 The mean slope is 10 degrees. 54% of all plots, representing 73% of the total cultivated area are on sites of less than 5 degrees slope. The mean slope of coconuts is 7 degrees and cocoa is planted on level sites. The mean slope of sweet potato plots is 10 degrees, with 50% of plots on sites of over 5 degrees of slope. Yam plots tend to be on steeper sites, with a mean slope of 19 degrees, and 50% of plots on sites of greater than 10 degrees slope. The mean slope of pana is 14 degrees, with 13% of pana plots on slopes greater than 20 degrees.

2.24 There is little sign of erosion as a result of agriculture and no conservation measures are practiced other than one occurrence of contour cultivation in a food garden.

2.25 The overall mean distance of gardens from households is .216 hours, with a maximum recorded distance of 1.40 hours. The larger tree crop gardens tend to be closest to the household while the larger food crop gardens tend to be furthest away. Short term cash crops are on small areas close to households.

Adverse Factors Affecting Production

2.26 73% of gardens have no apparent site limitations. Poor soil is regarded as a constraint on only 4% of gardens (4% of area); pests and disease are a problem on 7% of gardens (4% of area); weeds and related factors are a problem on 9% of gardens but affect 43% of the cultivated area.

2.27 The dominant problem is weeds on large coconut plantings. Various lesser forms of crop damage and limitations are experienced.

Crop Yields

2.28 Production data from the farming systems survey is not yet available and so indicative yields derived from secondary sources are summarised in table 2.1.

Table: 2.1
SMALLHOLDER CROP YIELDS

crop	condition	yield kg/ha
coconut	copra equivalent	800
cocoa	dry beans	600
sweet potato	> 8 years fallow	8,000
	4 - 8 years fallow	5,000
	< 4 years fallow	3,500
taro		5,000
yam	> 8 years fallow	10,000
	4 - 8 years fallow	6,000
	< 4 years fallow	4,500
pana	> 8 years fallow	10,000
	4 - 8 years fallow	6,000
	< 4 years fallow	4,500
cassava		10,000
maize		1,800
groundnuts		600

Text source: Table 14.5

Crop Production

2.29 Daily crop production has been measured by the Statistics Office in the Rural Services "Project Beneficiary Monitoring and Evaluation" exercise, and is summarised in table 2.2.

Table: 2.2
SMALLHOLDER PRODUCTION

Average daily production from entire household (kg):

commodity	Province and Site						
	Ysabel	Central	Guadalcanal	Malaita	Makira	Temotu	Average
	Susubona	Hakama	Marau Sound	Afio	NW Peninsula	Lata	
sweet potato	8.00	2.67	6.68	3.79	4.09	4.19	4.90
cassava	1.26	0.98	2.15	0.35	0.63	0.04	0.90
yam	0.68	1.68	0.71	2.25	0.65	0.90	1.14
pana	0.58	4.60	0.32	0.06	0.34	0.12	1.00
taro	0.71	0.32	0.45	1.60	1.37	1.15	0.93
breadfruit	0.01		0.03	0.01		0.11	0.03
banana	0.55	0.56	1.85	0.83	2.06	0.28	1.02
sub-total	11.79	10.80	12.20	8.90	9.13	6.78	9.93
coconut	0.44	0.49	3.55	1.41	2.54	0.43	1.48
cabbage	0.24	0.26	0.40	0.75	0.71	0.32	0.45
other veg	0.29	0.12	0.24	0.05	0.37	0.08	0.19
other fruit	0.91	0.31	2.01	0.89	1.90	0.41	1.07
fresh meat			0.01		0.01	0.03	0.01
fresh fish	0.69	0.40	0.57	0.32	0.25	0.12	0.39
crab/shellfish	0.58	0.20	0.13	0.23	0.02	0.05	0.20
milk/eggs	0.01				0.00		0.00
betel nut	0.09	0.08		0.16	0.06	0.11	0.08
local tobacco		0.03			0.01	0.01	0.01
Based on observations from the following number of "household days":	1,200	960	480	840	1,200	720	900

Source: Statistics Office PBME unpublished results - courtesy of Statistics Office.
Text source: Table 15.1

2.30 On average there are **9.93kg** of staple crops produced daily, the crop composition varying according to area and season. With a national mean household size of **6.50** this would provide each man, woman and child with approximately **1.5kg** of staple root crop per day.

Labour

2.31 The dominant labour constraint expressed by farmers is on tree crops, where **78%** of the area under tree crops has a shortage of labour and **41%** is affected by a shortage of inputs or cash. In contrast only **8%** of the food garden area is affected by a shortage of inputs or cash, and there is no indication of a labour shortage. Distance to gardens is not regarded by farmers as a constraint.

2.32 Labour expenditure on the average holding is summarised in table 2.3 - presented firstly by crop (aggregating all operations), and secondly by operation (aggregating all crops).

Table: 2.3
LABOUR SUMMARY

	⟨------ work days per year -----⟩ ⟨----- per holding -----⟩				per ha	⟨- % contribution -⟩			labour cost
i) By Crop	men	women	paid	total	average	men	women	paid	(SI$)
Cleared Land									
Coconut	319	300	63	682	832	47	44	9	105
Cocoa	2	2		4	72	50	50		3
Grain Crops		9		9	880		100		
Cabbage									
Fruit Crops									1
Banana									
Tobacco									
Sweet Potato	42	214	2	258	1336	16	83	1	3
Yam	12	33		45	735	27	73		
Pana	4	2		6	285	67	33		
Cassava	1	1		2	160	50	50		
All Crops	380	561	65	1006		38	56	6	112

ii) By Operation									
Land Clearance	75	67	2	144		52	47	1	6
Cultivation	79	46	1	126		63	37	1	10
Planting	38	32		70		54	46		1
Tree Crops Establishment	28	102		130		22	78		
Tree Crops Maintenance	6	11	33	50		12	22	66	49
First Weeding	29	58	9	96		30	60	9	16
Second Weeding	24	42	2	68		35	62	3	4
Third Weeding	30	16	16	62		48	26	26	21
Harvesting	71	187	2	260		27	72	1	5
All Operations	380	561	65	1006		38	56	6	112
Available labour units	:1.83	2.31							
Days per unit labour	: 208	243	65						

Text source: Table 16.3

2.33 Overall there are 1,006 work days required on the average holding of which 380 are provided by men, 561 by women and 65 by paid labour at an annual cost of SI$112. The average adult man in the household spends 208 days working on the holding and the average adult woman spends 243 days, with an additional 65 days of hired labour.

2.34 Coconuts dominate the labour budget with a requirement of 682 work days per year. Root crops require a further 311 work days per year. Women provide 44% of the total labour on coconuts and almost all the labour on root crops. Overall women contribute 56% of labour, men provide 38% and 6% is accounted for by hired labour.

Cash Crop Processing

2.35 While 41% of farmers grow coconuts only 10% earn income from the sale of copra. The labour composition in the manufacture of copra is 81% family and 19% hired at an annual cost of SI$27.5. Copra production is labour intensive, requiring on average 240 work days per annum to produce 1,306kg copra, or 6.7kg copra produced per household work day. At the prevailing price of 33 cents per kilo this offers a net return of SI$1.97 per household work day. The net mean annual income from copra is SI$384.

2.36 3% of sampled farmers (one farmer) process cocoa with an annual production of 105kg dry beans. At a household labour input of 84 work days this represents a production of 1.25kg per work day. At the prevailing price of SI$1.80 per kilo the annual income is SI$187, or SI$2.23 per household work day.

Marketing

2.37 There is a weak association between price and the volume of crop sales but many producers do not appear particularly price responsive. There is a certain amount of cross-subsidisation in the marketing of crops, where it would otherwise be uneconomic to sell small volumes or low value crops. There are numerous marketing constraints, notably transport, but these are not regarded in general as severe.

Chapter: 3
HOUSEHOLD COMPOSITION

3.1 The analysis of household composition in the farming systems survey is to set production and management information in a social context and to establish labour availability. New demographic data are becoming available from the 1986 census and these provide background to survey results. Table 3.1 summarises some early results of the census (1).

Table: 3.1
POPULATION CHARACTERISTICS
(from the 1986 census)

Province	Western	Ysabel	Central	Guadal	Honiara	Malaita	Makira	Temotu	Total
1986 population	55,250	14,616	18,457	49,831	30,413	80,032	21,796	14,781	285,176
annual growth rate	3.0	3.2	2.9	4.3	6.8	2.7	3.6	2.8	3.5
% national population	19	5	6	17	11	28	8	5	100
peri-urban population	3,710	1,901	1,622		30,413	3,252	2,588	1,295	44,781
% peri-urban	7	13	9	38		4	12	9	16
males	29,202	7,329	9,850	26,251	17,293	39,605	11,174	7,268	147,972
females	26,048	7,287	8,607	23,580	13,120	40,427	10,622	7,513	137,204
sex-ratio	112	101	114	111	132	98	105	97	108
number of households	7,942	2,362	3,079	8,072	4,317	12,417	3,278	2,375	43,842
household size	6.96	6.19	5.99	6.17	7.04	6.45	6.65	6.22	6.50
Age composition (%)									
0 - 14	46.4	48.8	45.7	46.8	39.2	50.2	50.7	49.6	47.3
15 - 29	27.2	22	26	27.2	35.7	21.7	23.3	23.3	25.8
30 - 44	13.5	13.9	14.4	14	17.1	13.2	13.1	13.3	13.9
45 - 59	8	8.5	8.2	7.3	5.8	9.1	8.2	8.5	8.1
60 +	4.9	6.7	5.7	4.6	2.1	5.7	4.6	5.5	4.9

Source: Statistics Office Statistical Bulletin 3/88

3.2 In November 1986 the population of Solomon Islands was 285,176 with an annual growth rate of 3.5%. The national mean household size was 6.5, resulting in a total of 43,842 households, of which at least 84% are rural. Guadalcanal, Malaita and Western Provinces account for 77% of the national population.

3.3 The age composition of the Solomon Islands population is young with a wide based, tapering population pyramid. The "dependency ratio" (the number of persons under 15 years and over 60 years of age per 100 persons aged 15 to 59 years) is **109**[2].

3.4 The total fertility rate is **6.4** children per woman at the end of her child bearing age. The life expectancy at birth among males is **59.9** years, and among females is **61.4** years. Male infant mortality is **40** per thousand live births compared with a female infant mortality of **36** per thousand live births[2].

3.5 In the census **40,046** persons attended school during 1986, although some disruption was caused by Cyclone Namu. Among all persons aged 5 years and over not attending school in 1986, **51%** had no education. Primary school attendance spans a wide age range, but **20%** of age group 10 to 24 never attended school.

3.6 **94.2%** of the Solomon Islands population is Melanesian, 3.7% Polynesian and 2.1% other ethnic groups, but mainly Kiribati. 17% of the census population were residing in a province other than that of their birth, indicating a considerable level of internal migration. Onward movement is particularly strong from Malaita, resulting in net out-movement. This is true for provinces other than Central and Guadalcanal which experience a net in-movement. All provinces showed a net movement to Honiara.

3.7 Household composition results from the farming systems survey are summarised in table 3.2. Age categories are chosen to provide approximate conversion into "available labour units". The membership of a household often includes relatives, and less commonly non-relatives (these are both referred to as "relatives" in the table), and both family and non-family members define the "de facto" household size. This is the actual number of people residing in the household and is illustrated in diagram 3.1. A second measure of household composition is the number of immediate family members (father, mother, sons and daughters) either living at home or living away. This is known as the "de jure" family size.

3.8 In the survey area the average family size is **7.55**. With **12%** of family members living away from home, a household has on average **7.00** members, of which **6.61** are immediate family and the remainder relatives or others residing in the household. Those living away are mostly male, in the economically active age group 16 - 55. Of **3.76** male family members **3.02** live at home, representing a net onward movement of **25%** among male family members. This is not compensated for by non-family male household members, since there are only **3.10** males in the household.

Table: 3.2
HOUSEHOLD COMPOSITION
(from the farming systems survey)

Mean Number of Household Members:

MALE					AGE GROUP	FEMALE				
living at HOME			AWAY			living at HOME			AWAY	
Head	Family	Relative	Family			Head	Family	Relative	Family	
0.18	0.05				> 55		0.08	0.03		
0.63	0.70	0.05	0.58		16 - 55	0.15	1.48	0.15	0.15	
	1.03	0.03	0.10		6 - 15		1.45	0.13	0.05	
	0.38		0.03		2 - 5		0.40			
	0.05		0.03		0 - 1		0.03			total
Category total:	0.81	2.21	0.08	0.74		0.15	3.44	0.31	0.20	7.94
Family at home:		3.02					3.59			6.61
De Facto total:			3.10					3.90		7.00
De Jure total :				3.76					3.79	7.55

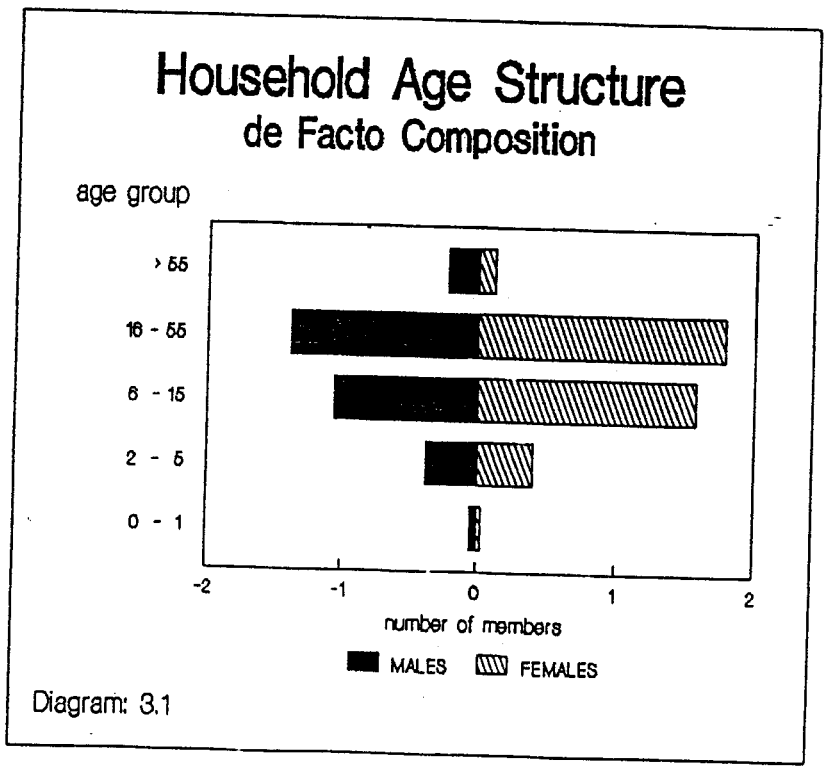


Diagram: 3.1

3.9 Of 3.79 female family members 3.59 live at home, representing a **6%** onward movement. In contrast to males, this is more than compensated for by additional non-family female members living in the household since there are altogether 3.90 female members of the household.

3.10 There is then a net out movement of males, predominantly in the economically active age group. There is some out movement of females, but this is more than compensated for by an overall inward movement of female household members - of female relatives or other non-family members attached to the household. This results in a gender imbalance of **3.90** female household members compared with 3.10 males, a ratio of **80%** males to females.

3.11 These findings may be attributed to the presence of a Malaitan community settled in the Marau Sound area, although it has not been possible within the bounds of the survey to verify this.

3.12 De facto household composition is converted into "adult equivalent labour units" in table 3.3 according to factors employed by Bathgate[18] (although there are slight differences in age classes between the two studies). An average household of **4.14** labour units is made up of **1.83** male units and **2.31** female units. Women account for **56%** of household available labour compared to **44%** from men.

Table: 3.3
HOUSEHOLD LABOUR AVAILABILITY

Mean number of members by age group:

MALES de Jure	MALES de Facto	MALES labour	AGE GROUP	FEMALES de Jure	FEMALES de Facto	FEMALES labour	TOTAL de Jure	TOTAL de Facto	TOTAL labour
0.23	0.23	0.13	> 55	0.08	0.11	0.06	0.31	0.34	0.19
1.91	1.38	1.38	16 - 55	1.78	1.78	1.78	3.69	3.16	3.16
1.13	1.06	0.32	6 - 15	1.50	1.58	0.47	2.63	2.64	0.79
0.41	0.38		2 - 5	0.40	0.40		0.81	0.78	
0.08	0.05		0 - 1	0.03	0.03		0.11	0.08	
Total 3.76	3.10	1.83		3.79	3.90	2.31	7.55	7.00	4.14

Labour availability assumes the following conversion factors:

age class	factor
> 55	0.6
16 - 55	1.0
6 - 15	0.3
0 - 5	0.0

Chapter: 4
INCOME EARNING ACTIVITIES

4.1 2.5% of rural households in the country were enumerated in the 1982 Household Income and Expenditure Survey [3] conducted by the Statistics Office of the Ministry of Finance. Virtually all rural households had food gardens. **39%** sold copra and **41%** sold garden produce, with an average monthly income from sales of SI$ 56. A summary of income earning activities according to the 1982 survey compared with the 1986 population census is presented in table 4.1.

Table: 4.1
1982 INCOME AND EXPENDITURE SURVEY: SALES

activity	% households earning income	
	1982	1986
copra	39	29
coconut	18	
cocoa	0.38	9
betel nut	1.25	17
other cash crop	12	
garden produce	41	34
cattle		2
pigs		12
poultry		10
fish	24	17
crabs, lobster		4
beche de mer		12
shells	7	
carvings	4	
hand crafts	0.38	4
canoes		3
mats, baskets		10
thatch		4
houses		5
other sales	1.13	

Source: Statistics Office Natioanl Accounts Discussion Document No 2
Statistics Office Bulletin 12/88

4.2 These figures show the importance of garden produce sales as an income earning activity, although the relative magnitude of earnings is not known. Copra is the major cash earning commodity, showing an apparent contraction in the proportion of rural sales. By contrast cocoa sales have expanded.

4.3 In the 1982 survey 27% of rural households had at least one member in paid employment, from which the average monthly wage was SI$103. 16% had their own business and 39% of households had a share in a cooperative (although it is stated that this result should be treated with caution). 10% of households held a loan, with an average monthly repayment of SI$87, the majority with the Development Bank of Solomon Islands.

4.4 On average a household spent SI$57 per month on goods and services of which 47%, or SI$27, was on food. Less frequent expenditures amounted to SI$5 per month.

4.5 Reported (cash and non-cash) income was SI$147 compared to monthly expenditures of SI$131. The average cash component of income amounted to SI$86 per month compared with expenditures of SI$74. The excess of 17% in income over expenditure was believed to be due to the underestimation of production costs rather than the true value of rural savings.

4.6 The 1986 census [2] found that 25% of the population aged 14 years and over was working for money (the week before the census enumeration), and about half of those also performed village work such as track clearing and church construction. About 80% of those not engaged in cash employment performed village work.

4.7 35% of males were engaged in cash employment compared with 13% of females. The 1982 Household Income and expenditure survey also states that "generally boys had a better chance of attending school than girls". These findings coincide with results in the previous chapter indicating that economic and educational prospects for females in the survey area appear poorer than for males.

4.8 The rural economy is diverse, with a variety of farm and off-farm activities which may contribute to household income. Results from the farming systems survey are presented in table 4.2. The table describes the proportion of households undertaking income earning activities in the survey area. Rural income and expenditure patterns are covered by other (non AES) surveys - planned or recently undertaken - and so the present survey describes only the frequency, not the relative importance, of each activity.

Table: 4.2

INCOME EARNING ACTIVITIES

	⟨---- % households ----⟩ by activity individual	group	summary of individual activities
Households Earning Income Over the Past Year From:			
COCONUTS			
Coconuts	8	10	+++
Copra	8	10	+++
Coconuts and Copra	3		+
Total	18		
COCOA			
Wet beans			
Dry Beans	5	5	++
Wet and Dry Beans			
Total	5		
OTHER CROPS			
Food Crops	28	35	++++++++++++
Other Cash Crops	3	8	+
Food and Cash Crops	5		++
Livestock	5	8	++
Food crops and Livestock	3		+
Cash Crops and Livestock			
Food, Cash Crops and Livesock			
Total	43		
FISHING			
Fish	20	28	++++++++++
Shellfish	5	13	++
Fish and shellfish	8		+++
Crabs, etc			
Fish and Crabs			
Shellfish and Crabs			
Fish, Shellfish and Crabs			
Total	33		
LOGGING/MINING			
Logging			
Sawmill			
Logging and Sawmill			
Mining			
Logging and Mining			
Sawmill and Mining			
Logging, Sawmill and Mining ..			
Total			

INCOME EARNING ACTIVITIES (continued)

	(---- % households by activity ---- individual	group	summary of individual activities
PROFESSION			
Teacher			
Government Employee			
Other Profession	5	5	++
Total	5		
COOPERATIVE			
Crop Production Cooperative ..	5	5	++
Marketing Cooperative	3	3	+
Crop and Marketing			
Cooperative Shop	10	10	+++++
Crop and Shop			
Marketing and Shop			
Crop, Marketing and Shop			
Total	18		
BUSINESS			
Private shop	18	18	++++++++
Vehicle Hire			
Shop and Vehicle			
Crafts	5	5	++
Shop and Crafts			
Vehicle and Crafts			
Shop, Vehicle and Crafts			
Total	23		
SKILLED TRADE			
Joiner/housebuilder		3	
Mechanical Trade			
Joiner and Mechanical			
Other Skilled Trade		3	
Joiner and Other	3		+
Mechanical and Other			
Joiner, Mechanical and Other .			
Total	3		

4.9 In the table are two columns, entitled "individual" and "group". Individual activities distinguish between combinations of activities - treating for instance "food crops" (only), "livestock" (only) and both "food crops and livestock" as three distinct activities. The percentages of households for individual activities are additive, and are shown as a "total" for each set of related activities in the table.

4.10 Under group activities - all occurrences of "food crops" and all occurrences of "livestock" are summarised under the two main headings, since "livestock" and "food crops and livestock" are both livestock activities. "Group" activities represent an alternative summary for the data set, and are non additive.

4.11 To the right of table 4.2 is a histogram summary of individual activities. Diagram 4.1 provides a visual summary of grouped activities.

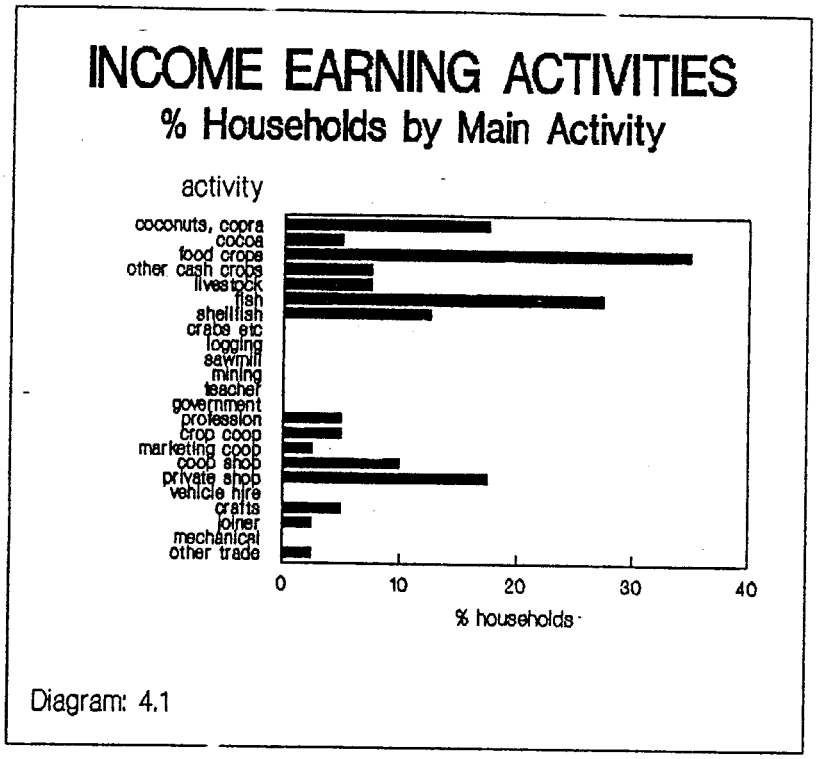


Diagram: 4.1

4.12 Results in table 4.2 are broadly in line with the 1982 Household Income and Expenditure survey and the 1986 Population Census, although all three show wide variations which may be partly attributed to differences in time, scope and scale of coverage.

4.13 In the present study the most frequent income earning activity is the selling of food crops, undertaken by 35% of households. This is followed by fishing, from which 28% of households earn income , and 13% from selling shellfish. Only 18% of households in the survey earn income from coconuts and copra, which is appreciably lower than national estimates from previous studies.

4.14 5% of households earn income from cocoa. Livestock is an income earning activity for 8% of households.

4.15 Trade is important. 18% of survey households earn income from running a private shop and 10% are associated with cooperative shops. Skilled trades, professions and crafts are also income earning activities.

Chapter: 5
EXTENSION AND MASS MEDIA

5.1 Table 5.1 summarises the penetration of mass media and extension in the survey area.

Table: 5.1
EXTENSION AND MASS MEDIA

	% households	summary
i) Households Listening to Agricultural Programmes on the Radio:		
Never listen	33	++++++++
Listen weekly	25	++++++
" monthly	3	.
" occasionally	40	++++++++++
Total	100	
ii) Households with Members who can Read and Write:		
Not able to read or write	5	+
Able to read		
" write		
" read and write	95	++++++++++++++++++++++++
	100	
iii) Households Visited by (any type of) Extension Worker:		
Never been visited	63	++++++++++++++++
Visited very occasionally	13	+++
" once per year	10	++
" " " 6 months	5	+
" " " 3 months	3	.
" " " month		
" " " week		
Don't know	8	+
	100	
iv) Households in which Members have Attended Training:		
Never attended training	78	++++++++++++++++++
Attended village meeting		
" day course at training centre	3	.
" village meeting and day course		
" residential course	18	++++
" village meeting and residential course		
" day and residential course	3	.
" village meeting, day and residential course		
	100	

5.2 Travel and communication are difficult in Solomon Islands, with scattered islands of low population densities. Radio offers a means of communicating throughout the country, albeit one-way, and in a medium which makes few demands on literacy. In the survey **28%** of households regularly listen to agricultural programmes on the radio, either weekly or monthly. **40%** listen occasionally but **33%** never listen to agricultural programmes. With **67%** of households listening to agricultural programmes at least occasionally, radio is an appropriate medium for communicating agricultural and other development information. Problems experienced in the field include access to working radios and the ability among farmers to set aside time to listen to programmes.

5.3 The second part of the table shows the proportion of households in which at least one member is able to read or write. According to these results **95%** of households have at least one member with some reading and writing skills. The survey was unable to verify the level of skills or to substantiate this finding objectively, but the result suggests that simple written materials are an appropriate extension medium. In more general terms, pictural materials would be popular together with simple text and annotation.

5.4 The frequency of extension visits is investigated in the third part of the table, and is illustrated in diagram 5.1.

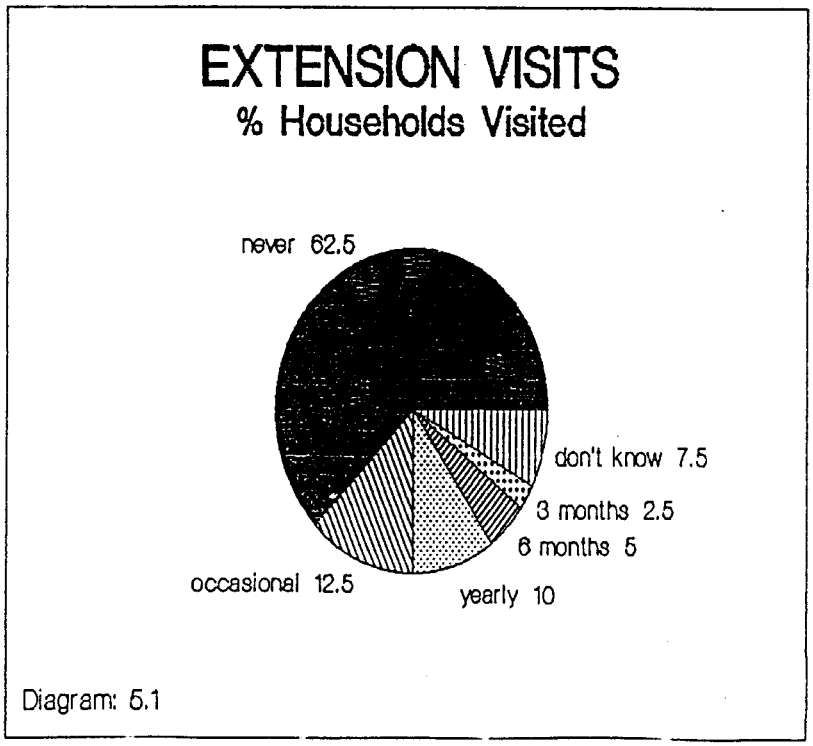


Diagram: 5.1

5.5 Extension in the present study refers to any agricultural worker in government extension, research, NGOs or other organisations. Less than **10%** of households are visited with any regularity at 3 to 6 monthly intervals. No household has been visited more regularly than once in 3 months, and **63%** of households have never been visited by any type of extension worker.

5.6 Extension visits where they take place are infrequent. A more penetrating study would be justified since it has not been possible in the present survey to expand on these results. It is, however, clear that extension faces severe problems throughout the country in terms of backup and support due to the difficulties of transport and communications, and in funding programmes.

5.7 The fourth part of table 5.1 describes agricultural training. **78%** of households have never participated in any form of agricultural training. Among those that have, training has been in the form of formal sessions at training centres. Again it has not been possible within the terms of the present study to investigate the nature of such training. There is no record of village training based around meetings, suggesting that there may be scope for improvement in the orientation and methodology of extension, and support and resources allocated to it. A more specific study of extension and training would be justified, since it is not possible in the present exercise to more than highlight selected issues.

5.8 In extension elsewhere it is often found that there is a bias towards more responsive farmers, or programmes may be specifically targetted at them. Such farmers may become "leading farmers" who are expected to adopt rapidly and to demonstrate technologies to other more conservative or risk conscious farmers, who may adopt more slowly over time. The success of such an approach often depends on how representative the leading farmer is of the community as a whole.

5.9 In the development of an extension system it is important to know something about the type of farmers being contacted, and the nature of contacts to ensure that there are no hidden constraints. Table 5.2 describes the relationship between extension visits and the scale and nature of agricultural operations.

Table: 5.2
VISITS BY HOLDING SIZE

Mean size of holding (ha) by frequency of visits

frequency of visits	all holdings			tree crop holdings			non-tree crop holdings		
	size (ha)	obs	% obs	size (ha)	obs	% obs	size (ha)	obs	% obs
all visits	1.17	39	100	2.25	16	100	0.29	23	100
never visited	1.37	24	62	2.61	11	69	0.31	13	57
very occasionally	0.24	5	13	0.27	1	6	0.23	4	17
once per year	2.42	4	10	2.97	3	19	0.79	1	4
six months	0.20	2	5				0.20	2	9
three months	0.30	1	3				0.30	1	4
month									
week									
don't know	0.40	3	8	0.95	1	6	0.12	2	9

5.10 The table is in three parts, firstly describing extension coverage among all farmers, secondly for farmers with tree crops (predominantly coconuts), and thirdly for subsistence farmers with no tree crops. Each part of the table shows the mean holding size for each category.

5.11 Extension intensity is low but there is no apparent relationship between holding size and extension visits, and non-tree cropping farmers experience similar coverage to tree cropping farmers. There is little extension bias, but conversely little extension focus.

5.12 Table 5.3 investigates the relationship between extension visits and whether the farmer holds a position of authority in the community.

Table: 5.3
VISITS BY LOCAL AUTHORITY

frequency of visits	type of authority (number of observations)			type of authority (% observations)		
	none	chief	other	none	chief	other
all visits	23	8	8	59	21	21
never visited	13	7	4	33	18	10
very occasionally	4		1	10		3
once per year	3		1	8		3
six months	1		1	3		3
three months			1			3
month						
week						
don't know	2	1		5	3	

Note: "Other" = church, political, cooperative leader, etc.

5.13 **41%** of farmers held some position of local authority. Since equal probability sampling methods were used, these farmers are not necessarily unrepresentative of the community as a whole. There is no evidence of bias or the targetting of programmes towards community leaders.

5.14 Extension activities appear broad based but lack intensity. There is considerable scope for the intensification of extension programmes through the provision of materials and equipment, operating expenses, training and supervision, and backup and support.

Chapter: 6
LIVESTOCK

6.1 Livestock, particularly small stock such as pigs and chickens, are an important feature of smallholder agriculture in Solomon Islands.

6.2 The number of cattle in the 1985 census was **19,750** - a fall of **13.1%** from 1984 due largely to destocking in the plantation sector. Overall the national herd was **22%** below its peak of 1978, with an average annual fall of **3.4%** [4].

6.3 The smallholder sector accounted for **7,612** cattle, **39%** of the national herd, showing a decline of **4.1%** from the 1984 census. The distribution of cattle throughout the country is shown in table 6.1.

Table: 6.1
CATTLE DISTRIBUTION IN 1985

Province	total cattle	% distribution
Western	4,841	25
Ysabel	1,110	6
Central	2,081	10
Guadalcanal	6,292	32
Malaita	3,810	19
Makira	1,462	7
Temotu	217	1
Total	19,750	100

Source: Statistics Office, 1985 Cattle Census

6.4 In the 1982 Income and Expenditure Survey [3] it was found that **37%** of households owned pigs, **30%** owned chickens, but only **8%** owned cattle. The provincial breakdown is shown in table 6.2.

6.5 According to the 1986 Population Census [2] **2%** of households earned income from cattle, **12%** earned income from pigs and **10%** earned income from poultry.

Table: 6.2
LIVESTOCK DISTRIBUTION IN 1982

Province	% households owning		
	cattle	pigs	chickens
Western	2	19	24
Ysabel	42	25	47
Central		28	7
Guadalcanal	2	63	41
Malaita	9	35	28
Makira	10	69	63
Temotu		40	4
Total	8	37	30

Source: Statistics Office, 1982 HH Income and Expenditure Survey

6.6 In the present survey 8% of households earned income from livestock (table 4.2).

6.7 Table 6.3 summarises livestock ownership in the survey area, and is divided into three columns. The first, entitled "ownership %", specifies the percentage of households which own livestock. The middle two columns show mean stock held: firstly among livestock owning households (owners); and secondly as an average of all farmers in the survey area (both owners and non-owners). To the right of the table is a histogram summary of ownership based on the mean among all farmers.

6.8 The table is divided horizontally into three main parts. The first part specifies stock numbers kept predominantly for home use, but which may include occasional sales. The second part specifies stock numbers where livestock comprise an income earning enterprise. The third part is the overall mean of livestock ownership irrespective of type of enterprise. (Note that overall mean ownership figures are derived from the original data and may not be obtained from summation of the table entries above).

6.9 At the foot of the table is a component on novel livestock enterprises, such as bees, butterflies and crocodile farming. None of these were encountered among surveyed farmers.

Table: 6.3
LIVESTOCK

Livestock Ownership:

	ownership %	(-- mean ownership among --) owners	all farmers	summary all farmers
i) Non-commercial				
Cattle	3	10.00	0.25	+
Pigs	63	4.88	3.05	++++++++++++
Goats				
Chickens	57	10.70	6.15	++++++++++++++++++++++++
Ducks	10	5.50	0.55	++
Horses				
ii) Commercial				
Cattle	5	5.50	0.27	+
Pigs				
Goats				
Chickens	5	22.50	1.13	++++
Ducks	3	7.00	0.18	.
Horses				
iii) Total				
Cattle	8	7.00	0.52	++
Pigs	63	4.88	3.05	++++++++++++
Goats				
Chickens	58	12.65	7.28	++++++++++++++++++++++++++++
Ducks	10	7.25	0.73	++
Horses				

iv) Households Earning Income	(---- % households ----) by activity individual	group
Income from:		
1. Bees or honey		
2. Butterflies		
3. Bees and Butterflies		
4. Crocodiles		
5. Bees and crocodiles		
6. Butterflies and crocodiles		
7. Bees, butterflies and crocodiles		

6.10 The most important livestock in the survey area are pigs and chickens. Some cattle remain from former community projects, with **8%** (3 in the sample) of farmers owning cattle with a mean herd size of 7 head.

6.11 Pigs play an important role in the custom and life of rural households - kept mainly for traditional feasts such as at weddings; for the settlement of disputes between families or clans, commonly over land; and as compensation when customs are violated (especially where sacred places are disturbed). Pigs may be sold, often to pay for shell money or for cash needed as part of a bride price, for school fees, or for important traditional functions.

6.12 In the survey area **63%** of farmers keep pigs, entirely for "home use", with a mean herd size of **4.88** among owners.

6.13 Traditionally pigs were allowed to forrage unattended during the day and would be locked in pig huts at night. More commonly they are now fenced, both to protect gardens from marauding pigs, and for security to safeguard pigs from theft. Fences may be of wire, but are more commonly of wood or stone, typically housing one or two pigs. Fencing requires that the owners feed and water the pigs in the morning and again in the evening, in which the entire family participates. Pigs are commonly fed on cooked sweet potato, taro, yams and coconut kernals. This may be occasionally supplemented with scraps of fish and green fodder.

6.14 Pigs are generally kept fairly close to the household and the time spent in tending pigs is relatively minor in relation to garden work. If the farmer wants to breed piglets to sell, he will commonly hire a boar either for money or in exchange for a piglet.

6.15 Chickens are of lesser importance in the traditions and lives of local people and are not used in ceremonial functions. They are largely kept for food, and are especially important at Christmas. Sales are fairly common.

6.16 Chickens are kept by **58%** of households with a mean flock size of **12.65** among owners. Two farmers, or **5%** of sampled farmers, keep chickens commercially with a mean flock size of **22.5**.

6.17 Chickens may be fenced with bush materials to safeguard them from attack by dogs or from theft, or they may be left to find their own roosts. Chickens are not generally fed or watered, although occasional scraps and ground coconut kernal may be provided.

6.18 Chickens generally require little or no labour. They are kept around the homestead but breed unsupervised and their eggs and chicks are unprotected.

6.19 Ducks are of lesser importance, owned by 10% of households with a mean flock size of 7.25 among owners. As with chickens, ducks are kept under minimal management.

Chapter: 7
HOLDING SIZE DISTRIBUTION

7.1 Holding size distribution is of interest because it provides an understanding of the structure of agriculture and may help to explain constraints on adoption or response to services.

7.2 Table 7.1.i describes the holding size distribution of the survey area. Holdings are not spread normally about the mean of **1.169ha** but are skewed, in that many farmers have very small holdings while a few have comparitively large holdings. As a result **59%** of farmers have holdings less than **0.5ha** in size, and over **74%** of farmers have holdings less than the mean size of **1.169ha**. This can be seen clearly in diagram 7.1 which shows that the majority of farmers fall in the low holding size classes, while a few large holdings dominate the area distribution.

7.3 The mean describes the "average" holding size and is of interest in that it provides a value for the "middle" of the data based on the spread of values. This may be misleading when unbalanced extreme values occur, as seen in the present results since three quarters of farmers fall below the mean holding size and only a quarter are above it.

7.4 Another measure of central tendency is the median, or "mid-point", the value of the middle item when the data are arranged in order. In a "normal distribution" the median and the mean coincide. The median in this case is **0.360ha** indicating that skewness in the holding size distribution needs to be taken into account when considering the mean holding of 1.169ha.

7.5 An indicator of variability is the range, which is derived from extremes in the data. The minimum area is **0.075ha** and the maximum is **10.764ha**, a range of **10.690ha**. This shows that holding sizes are widely spread and that the mean falls towards the lower end of the range. Holdings are "positively skewed" because some relatively high values are not offset by corresponding low values. In diagram 7.1 it can be seen that the holding distribution is almost the reverse of the area distribution.

7.6 The standard deviation is a measure of variation based on the extent to which values deviate from the mean. If the data are closely bunched the standard deviation is small, and if they are widely spread it is large. In a normal distribution 68% of values lie within 1 standard deviation on either side of the mean, and 95% within 2 standard deviations. In the survey results the mean of **1.169ha** has a standard deviation of **1.995** and a coefficient of variation of **171%** (the standard deviation expressed as a percentage of the mean).

7.7 Skewness is an index of symmetry in the data. A normal distribution is symmetrical about the mean, with a skewness coefficient of zero, whereas a skewed distribution has a longer "tail" on one side than the other. The present data have a skewness of **3.429** indicating high positive skewness.

7.8 Kurtosis is the extent to which the data cluster around a central point. When this occurs the distribution appears "peaked", as in the present data set, which is said to be "leptokurtic". Positive values of kurtosis indicate that the distribution is more peaked than normal. In the present data set the coefficient of kurtosis is **14.043**.

7.9 The indications are that there is considerable inequality in holding size distribution, which may be viewed in standard form in diagram 7.2. The diagonal represents the holding size distribution for equality and the curve below represents the actual (cumulative) holding size distribution. The area between the diagonal and the curve is the "area of inequality". The larger the area of inequality, the more unequal the holding size distribution. This may be expressed as an index, called the "Gini coefficient", which is the area between the two lines expressed as a proportion of the area of the triangle below the diagonal. The Gini coefficient ranges from 0 (for perfect equality) to 1 (for perfect inequality). The Gini coefficient here is 0.65, indicating considerable inequality.

Table: 7.1
HOLDING SIZE DISTRIBUTION

i) All holdings and all crops

holding size (ha)	number of holdings	mean area in class (ha)	total area in size class (ha)	⟨------- % --------⟩ holdings	area	⟨-- cumulative % --⟩ holdings	area
0 - .25	13	0.1604	2.09	33	5	33	5
.25 - .5	10	0.3557	3.56	26	8	59	12
.5 - .75	3	0.5821	1.75	8	4	67	16
.75 - 1	3	0.8626	2.59	8	6	74	22
1 - 1.25	1	1.0972	1.10	3	2	77	24
1.25 - 1.5						77	24
1.5 - 1.75						77	24
1.75 - 2	3	1.7866	5.36	8	12	85	36
2 - 2.5	1	2.0400	2.04	3	4	87	41
2.5 - 3						87	41
3 - 5	4	4.0861	16.34	10	36	97	76
5 - 10						97	76
10 - highest	1	10.7641	10.76	3	24	100	100
Total	39	1.1688	45.58	100	100		

Mean	1.169	S.E. Mean	0.319
Median	0.360	Coef. of Var %	171
Std Dev	1.995	Variance	3.978
Kurtosis	14.043	S.E. Kurtosis	0.741
Skewness	3.429	S.E. Skewness	0.378
Range	10.689	Minimum	0.075
Maximum	10.764	Sum	45.582
Gini	0.647		

Note that the main table is a frequency distribution of grouped intervals, while the statistics at the foot of the table describe the ungrouped data set.

HOLDING SIZE DISTRIBUTION

all holdings - all crops

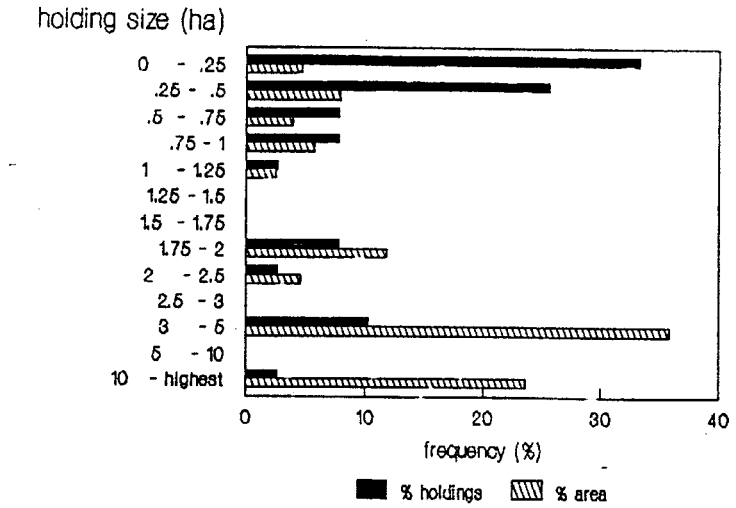


Diagram: 7.1

LORENZ CURVE

all holdings - all crops

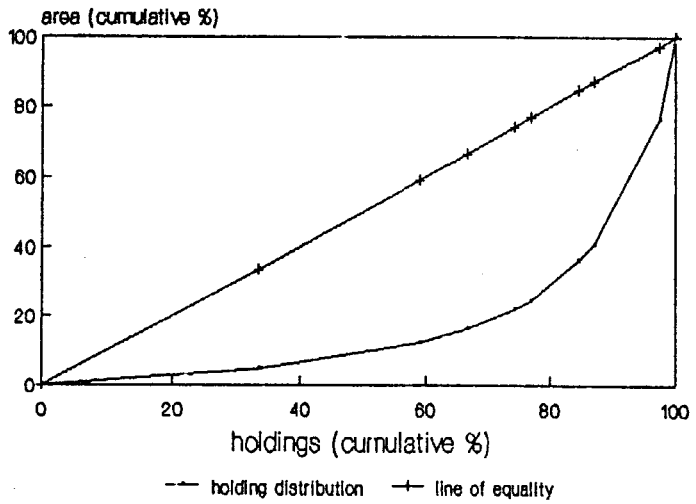


Diagram: 7.2

7.10 Table 8.1.ii shows the holding size distribution of only those farmers who have tree crops. The sample is reduced from 39 to 16, and so the stratum of farmers with tree crops represents **41%** of all farmers in the sample.

7.11 The mean holding size among tree cropping farmers is **2.427ha** and the median is **1.771ha**. The coefficient of skewness has dropped to **2.228** and kurtosis has fallen to **5.964**. The range remains wide, but the distribution is less scattered, with a coefficient of variation of **110%**.

ii) Holdings with tree crops

holding size (ha)	number of holdings	mean area in class (ha)	total area in size class (ha)	(------- % --------) holdings	area	(-- cumulative % --) holdings	area
0 - .25	1	0.2199	0.22	6	1	6	1
.25 - .5	2	0.3370	0.67	13	2	19	2
.5 - .75	1	0.5260	0.53	6	1	25	4
.75 - 1	2	0.9002	1.80	13	5	38	8
1 - 1.25	1	1.0972	1.10	6	3	44	11
1.25 - 1.5						44	11
1.5 - 1.75						44	11
1.75 - 2	3	1.7866	5.36	19	14	63	25
2 - 2.5	1	2.0400	2.04	6	5	69	30
2.5 - 3						69	30
3 - 5	4	4.0861	16.34	25	42	94	72
5 - 10						94	72
10 - highest	1	10.7641	10.76	6	28	100	100
Total	16	2.4266	38.83	100	100		

Mean	2.427	S.E. Mean	0.669
Median	1.771	Coef. of Var %	110
Std Dev	2.677	Variance	7.164
Kurtosis	5.964	S.E. Kurtosis	1.091
Skewness	2.228	S.E. Skewness	0.564
Range	10.544	Minimum	0.220
Maximum	10.764	Sum	38.826
Gini	0.499		

7.12 The new distribution of farmers with tree crops is illustrated in diagram 7.3, and its associated Lorenz curve in diagram 7.4. Inequalities have been reduced since the majority of small farmers are excluded, with a resultant rise in mean and median holding size; a drop in variability; and greater equality among tree cropping farmers, with a Gini coefficient of **0.499**.

HOLDING SIZE DISTRIBUTION
holdings with tree crops

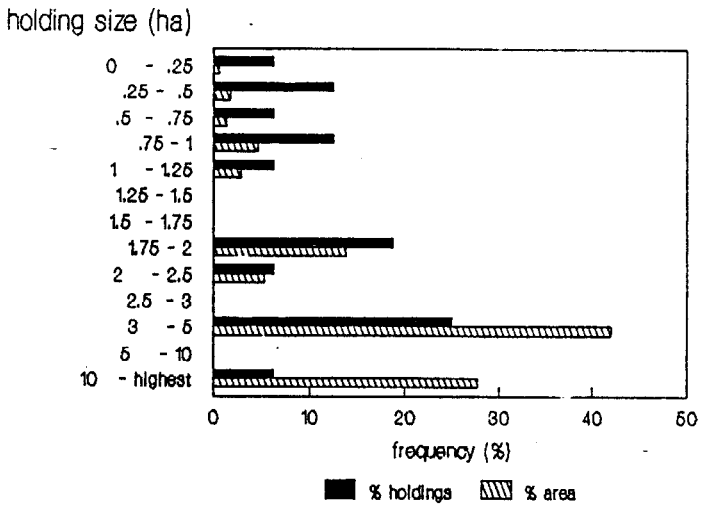


Diagram: 7.3

LORENZ CURVE
holdings with tree crops

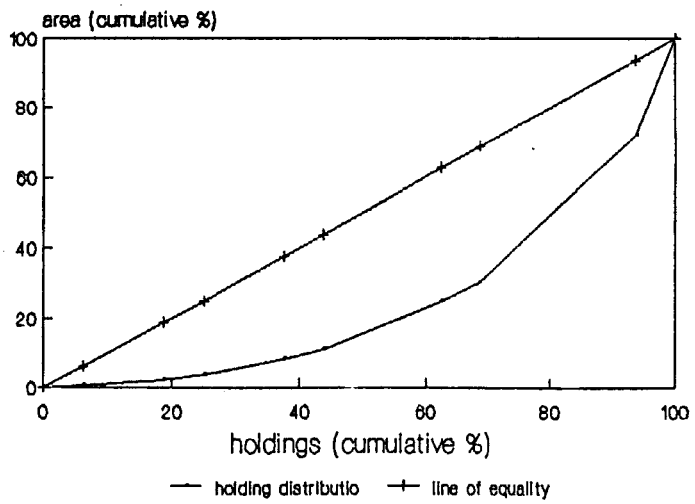


Diagram: 7.4

7.13 There remains considerable variability among farmers with tree crops, since there is a wide range in holding size. The stratum of farmers with no tree crops is shown in table 7.1.iii.

7.14 The majority of farmers do not have tree crops. The stratum contains 23 farmers, or **59%** of sampled farmers. The mean holding size is **0.294ha** and the median **0.242ha**. The range is small; skewness has dropped to **1.134**; and kurtosis to **0.901**. The distribution is much more normal, with a coefficient of variation of **64%**.

7.15 The holding size distribution is illustrated in diagram 7.5, and its associated Lorenz curve in diagram 7.6. Inequality is low, since the graph of % holdings and % area largely coincide, and the Gini coefficient has fallen to **0.332**.

iii) Holdings without tree crops

holding size (ha)	number of holdings	mean area in class (ha)	total area in size class (ha)	⟨------- % --------⟩ holdings	area	⟨-- cumulative % --⟩ holdings	area
0 - .1	3	0.0847	0.25	13	4	13	4
.1 - .2	7	0.1625	1.14	30	17	43	21
.2 - .3	4	0.2625	1.05	17	16	61	36
.3 - .4	4	0.3425	1.37	17	20	78	56
.4 - .5	2	0.4685	0.94	9	14	87	70
.5 - .6	1	0.5600	0.56	4	8	91	79
.6 - .7	1	0.6603	0.66	4	10	96	88
.7 - .8	1	0.7875	0.79	4	12	100	100
.9 - 1						100	100
1 - 1.5						100	100
1.5 - 2						100	100
2 - highest						100	100
Total	23	0.2938	6.76	100	100		

Mean	0.294	S.E. Mean	0.039
Median	0.242	Coef. of Var %	64
Std Dev	0.189	Variance	0.036
Kurtosis	0.901	S.E. Kurtosis	0.935
Skewness	1.134	S.E. Skewness	0.481
Range	0.713	Minimum	0.075
Maximum	0.788	Sum	6.756
Gini	0.332		

Note the smaller size classes in this table with respect to previous tables.

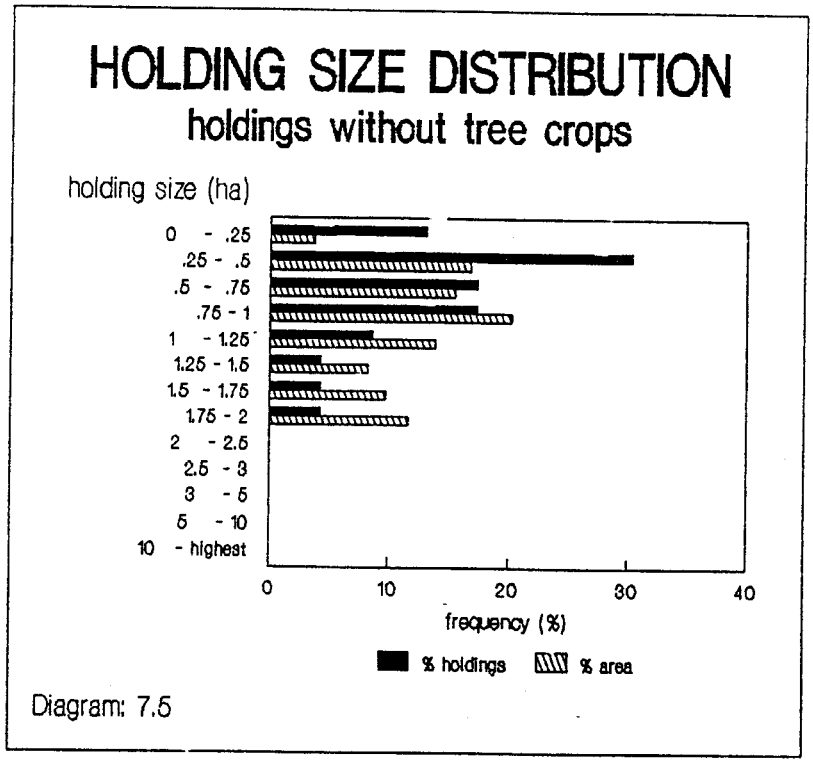


Diagram: 7.5

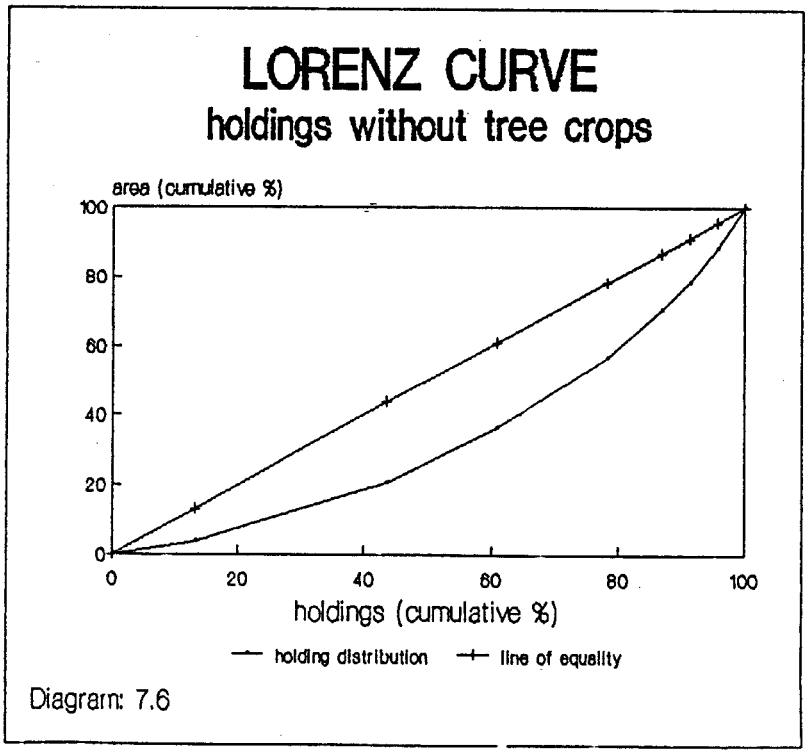


Diagram: 7.6

7.16 Table 7.1.iv describes the holding size distribution of all farmers, but excluding tree crops in the holding. The sample size has fallen to 38 indicating that one farmer grows only tree crops. Otherwise, 97% of farmers grow traditional "subsistence" crops. The holding size distribution is illustrated in diagrams 7.7 and 7.8. These results are similar to the previous ones for non-tree crop farmers, indicating that subsistence cropping is similar among all farmers.

iv) All holdings - total area excluding tree crops

holding size (ha)	number of holdings	mean area in class (ha)	total area in size class (ha)	(------- % --------) holdings	area	(-- cumulative % --) holdings	area
0 - .1	5	0.0799	0.40	13	3	13	3
.1 - .2	11	0.1551	1.71	29	14	42	17
.2 - .3	5	0.2675	1.34	13	11	55	28
.3 - .4	7	0.3497	2.45	18	20	74	49
.4 - .5	5	0.4651	2.33	13	19	87	68
.5 - .6	2	0.5764	1.15	5	10	92	78
.6 - .7	1	0.6603	0.66	3	5	95	83
.7 - .8	1	0.7875	0.79	3	7	97	89
.9 - 1						97	89
1 - 1.5						97	89
1.5 - 2	1	1.2713	1.27	3	11	100	100
2 - highest						100	100
Total	38	0.3181	12.09	100	100		

Mean	0.318	S.E. Mean	0.039
Median	0.282	Coef. of Var %	75
Std Dev	0.238	Variance	0.057
Kurtosis	5.885	S.E. Kurtosis	0.750
Skewness	1.980	S.E. Skewness	0.383
Range	1.219	Minimum	0.052
Maximum	1.271	Sum	12.088
Gini	0.365		

HOLDING SIZE DISTRIBUTION

all holdings excluding tree crops

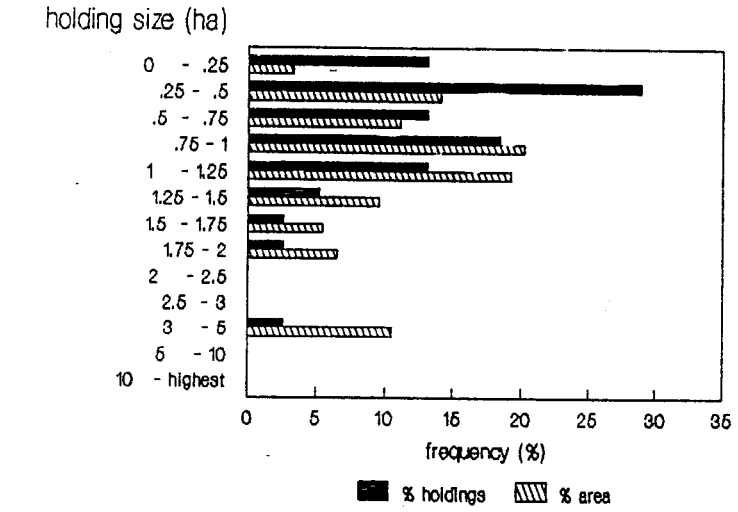


Diagram: 7.7

LORENZ CURVE

all holdings excluding tree crops

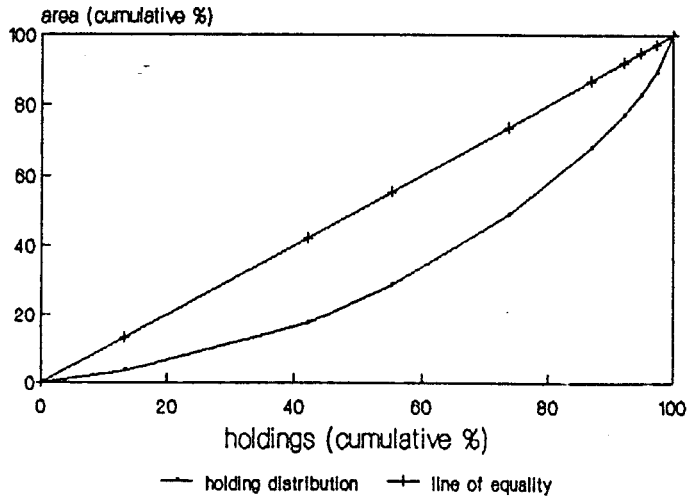


Diagram: 7.8

7.17 Table 7.1.v describes the size distribution of tree crop areas, illustrated in diagrams 7.9 and 7.10.

v) All holdings - total area of tree crops only

holding size (ha)	number of holdings	mean area in class (ha)	total area in size class (ha)	⟨------- % --------⟩ holdings	area	⟨-- cumulative % --⟩ holdings	area
0 - .25	3	0.1696	0.51	19	2	19	2
.25 - .5	1	0.4830	0.48	6	1	25	3
.5 - .75	1	0.5260	0.53	6	2	31	5
.75 - 1	2	0.8246	1.65	13	5	44	9
1 - 1.25	1	1.1966	1.20	6	4	50	13
1.25 - 1.5	1	1.3125	1.31	6	4	56	17
1.5 - 1.75	1	1.6529	1.65	6	5	63	22
1.75 - 2	1	1.9881	1.99	6	6	69	28
2 - 2.5	1	2.7071	2.71	6	8	75	36
2.5 - 3						75	36
3 - 5	3	3.6837	11.05	19	33	94	69
5 - 10						94	69
10 - highest	1	10.4187	10.42	6	31	100	100
Total	16	2.0934	33.49	100	100		

Mean	2.093	S.E. Mean	0.642
Median	1.255	Coef. of Var %	123
Std Dev	2.567	Variance	6.591
Kurtosis	7.516	S.E. Kurtosis	1.091
Skewness	2.510	S.E. Skewness	0.564
Range	10.293	Minimum	0.126
Maximum	10.419	Sum	33.494
Gini	0.542		

Note that the size classes are the same as for tables i and ii.

HOLDING SIZE DISTRIBUTION

all holdings - tree crops only

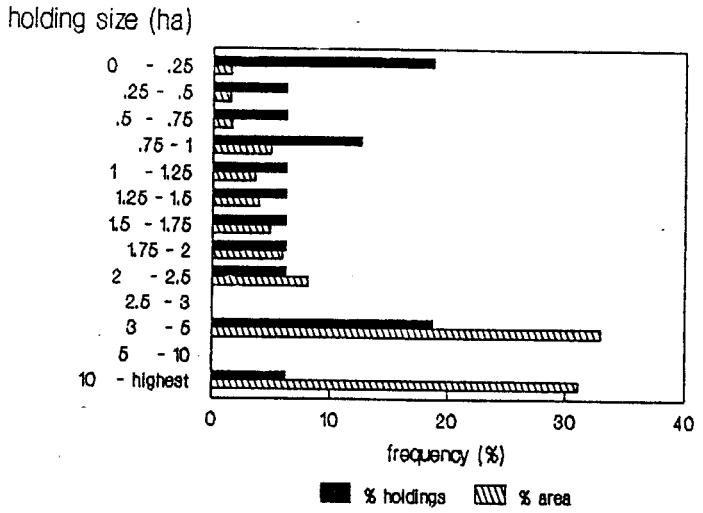


Diagram: 7.9

LORENZ CURVE

all holdings - tree crops only

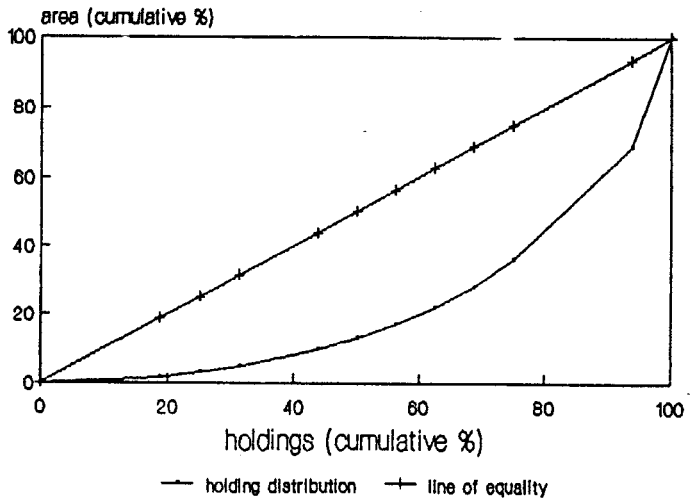


Diagram: 7.10

7.18 Indicators of variability are again high confirming that a large proportion of holding size inequality among smallholder farmers can be explained by tree cropping. The subsistence component of holdings is relatively uniform, while considerable variability is seen in tree crop, in this case coconut, areas.

7.19 In summary, inequality in holding size is largely explained by differences in tree cropping. **59%** of farmers do not grow tree crops and have a mean holding size of **0.294ha**. The **41%** of farmers who do grow tree crops have a mean holding size of **2.427ha**. Combined, the mean holding size is **1.169ha** but this is not a reliable "average". When partitioned, the subsistence operations of all farmers amount to a mean area of **0.318ha**, while the average area of tree crops among 41% of farmers is **2.093ha**.

Chapter: 8
LABOUR DENSITY

8.1 According to Bathgate[18] "increments in the population of a household do not result in an expansion in the garden area. Instead, the garden area holds constant and ... the actual area per consumption and labour unit decreases ... Although there is a variation ... the average household ... tends to clear a fairly similar amount of land for gardens and plant a similar area of root crops". Bathgate postulates that there is no relationship between household size and food garden area. Larger family sizes are not then associated with larger holdings, and he attributes this to a tendency among subsistence producers to cultivate in excess of household requirements as insurance against crop failure.

8.2 In the present survey the area of food crops is found to be relatively constant in comparison to a variabile tree crop area. Table 8.1 shows the relationship between holding size and labour availability.

Table: 8.1
LABOUR DENSITY - ALL HOLDINGS

holding size class (ha)	units of labour	mean holding area (ha)	labour density (labour/ha)	number of observations
all holdings	4.21	1.17	3.60	39
< .25	3.53	0.16	22.01	13
.25 - .5	4.41	0.36	12.40	10
.5 - .75	4.03	0.58	6.93	3
.75 - 1	3.43	0.86	3.98	3
1 - 1.25	7.30	1.10	6.65	1
1.25 - 1.5				
1.5 - 1.75				
1.75 - 2	4.57	1.79	2.56	3
2 - 2.5	5.00	2.04	2.45	1
2.5 - 3				
3 - 5	5.73	4.09	1.40	4
5 - 10				
> 10	3.00	10.76	0.28	1

Note: Labour units are for households with cultuvated land (39) and so differ from the overall mean over 40 households expressed in chapter 3.

8.3 There is little to suggest that larger holdings have more available labour, and so the present results are in agreement with Bathgate's findings. Labour density falls rapidly from 22.01 adult units per hectare for the smallest holding class (less than 0.25ha) to 0.28 units in the largest (greater than 10ha) class. Small holdings then have a high labour density while large holdings have a low labour density, as seen in diagram 8.1.

8.4 With a mean labour density of 3.60 labour units per hectare (which applies to holdings of less than 1.25ha), labour is unlikely to be limiting on small holdings, but it may be on larger holdings.

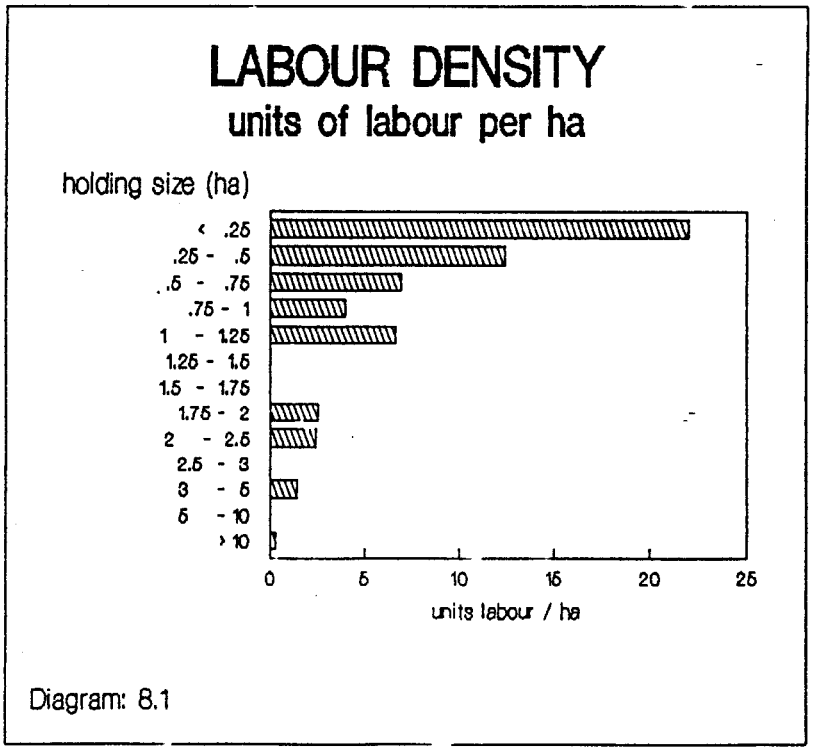


Diagram: 8.1

8.5 Holdings without tree crops are shown in table 8.2.

Table: 8.2
LABOUR DENSITY - NON-TREE CROP HOLDINGS

holding size class (ha)	units of labour	mean holding area (ha)	labour density (labour/ha)	number of observations
all holdings	3.90	0.29	13.29	23
< .25	3.38	0.16	21.70	12
.25 - .5	4.40	0.36	12.21	8
.5 - .75	5.25	0.61	8.60	2
.75 - 1	3.60	0.79	4.57	1
1 - 1.25				
1.25 - 1.5				
1.5 - 1.75				
1.75 - 2				
2 - 2.5				
2.5 - 3				
3 - 5				
5 - 10				
> 10				

8.6 The range of holding size is much smaller but again there is no evident relationship between holding size and labour availability. With a much higher mean labour density of 13.29 labour units per hectare, even the largest holdings of up to one hectare in size have a labour availability of 4.57 units per hectare. There is a sharp decline in labour density from 21.70 to 4.57 units per hectare over a holding size range of less than one hectare, but holdings in general have a high labour density.

8.7 Holdings with tree crops are shown in table 8.3.

Table: 8.3
LABOUR DENSITY - TREE CROP HOLDINGS

holding size class (ha)	units of labour	mean holding area (ha)	labour density (labour/ha)	number of observations
all holdings	4.66	2.43	1.92	16
< .25	5.40	0.22	24.56	1
.25 - .5	4.45	0.34	13.20	2
.5 - .75	1.60	0.53	3.04	1
.75 - 1	3.35	0.90	3.72	2
1 - 1.25	7.30	1.10	6.65	1
1.25 - 1.5				
1.5 - 1.75				
1.75 - 2	4.57	1.79	2.56	3
2 - 2.5	5.00	2.04	2.45	1
2.5 - 3				
3 - 5	5.73	4.09	1.40	4
5 - 10				
> 10	3.00	10.76	0.28	1

8.8 Again there is no evident relationship between holding size and labour availability. The mean labour density is 1.92 units per hectare, falling off sharply from 24.56 units per hectare on holdings of less than 0.25ha in size to 0.28 units per hectare on holdings of greater than 10ha.

8.9 Larger holdings may then experience labour constraints. There is unlikely to be a labour problem on food gardens, but there may be a shortage of labour for the management of tree crops.

8.10 It was not possible to investigate land use constraints for instance whether small holdings are small because of restricted land use rights. This is known to occur in some survey areas and would be a useful area of further study.

Chapter: 9
CROPPING PATTERNS

9.1 A "holding" is taken here to be the total area cultivated by a household. It includes all crops growing and land cleared, but does not include fallow which the family may have rights to cultivate.

9.2 A holding is divided into one or more "gardens", which are contiguous blocks of land growing similar crops. Only broad distinctions are made among crop types in gardens.

9.3 A garden may be subdivided into "plots" which are blocks within each garden growing a different crop mix, under different management, or planted at different times. Within plots detailed crop mixtures are recorded.

9.4 Table 9.1 describes cropping patterns at the garden level, maintaining the distinction between farmers who grow tree crops and those who do not.

9.5 Tree crop farmers have a mean holding size of **2.42ha**, of which **2.09ha** is tree crops and **0.33ha** food crops. In contrast, non-tree crop farmers have a mean holding size of **0.29ha**, **0.02ha** of short term cash crops and **0.27ha** of food crops.

9.6 Tree cropping farmers tend to have more complex holdings, with an average of **3.5** gardens and **4.81** plots compared with **2.22** gardens and **3.22** plots among non-tree crop farmers. The cultivation of short term cash crops among non-tree crop farmers is on a very minor scale.

9.7 Table 9.2 describes cropping patterns in more detail. This is derived from the aggregation of plot information in which complex mixtures are summarised by the dominant crop. **13** major crop mixture classes are listed in table 9.2, giving an indication of the complexity and diversity of smallholder agriculture in Solomon Islands.

Table: 9.1
CROP COMPOSITION

i) All holdings

crop category	mean area in holding (ha)	mean no gardens per holding	mean no plots per holding	mean no plots per garden	summary of crop area
cleared land					
tree crops	0.86	0.59	0.72	1.22	++++++++
short term cash crops	0.01	0.08	0.08	1.00	.
food crops	0.30	2.08	3.08	1.48	+++
total	1.17	2.75	3.88	1.41	

number of observations = 39

ii) Holdings with tree crops

crop category	mean area in holding (ha)	mean no gardens per holding	mean no plots per holding	mean no plots per garden	summary of crop area
cleared land					
tree crops	2.09	1.44	1.75	1.22	++++++++++++++++++++
short term cash crops					
food crops	0.33	2.06	3.06	1.49	+++
total	2.42	3.50	4.81	1.37	

number of observations = 16

iii) Holdings without tree crops

crop category	mean area in holding (ha)	mean no gardens per holding	mean no plots per holding	mean no plots per garden	summary of crop area
cleared land					
tree crops					
short term cash crops	0.02	0.13	0.13	1.00	.
food crops	0.27	2.09	3.09	1.48	++
total	0.29	2.22	3.22	1.45	

number of observations = 23

Table: 9.2
CROPPING PATTERNS

	main crop in mixture	all farmers		farmers with no tree crops		farmers with tree crops	
		(-- area --) (ha)	%	(-- area --) (ha)	%	(-- area --) (ha)	%
a	Cleared Land	0.002	0			0.006	0
b	Coconut	0.818	70			1.995	82
c	Cocoa	0.041	3			0.099	4
d	Pasture						
e	Grain Crops	0.011	1	0.019	7		
f	Beans	0.001	0	0.001	0		
g	Cabbage	0.001	0	0.002	1		
h	Vegetables						
i	Spices						
j	Fruit Crops	0.007	1	0.007	2	0.007	0
k	Fruit trees						
l	Banana	0.002	0	0.003	1		
m	Citrus trees						
n	Nut trees						
o	Sugar cane						
p	Food/building tree						
q	Tobacco	0.000	0			0.000	0
r	Sweet Potato	0.192	16	0.189	64	0.196	8
s	Taro						
t	Yam	0.063	5	0.047	16	0.086	4
u	Pana	0.024	2	0.024	8	0.024	1
v	Cassava	0.007	1	0.002	1	0.014	1
w	Other root crop						
	Total mean area (ha)	1.169		0.294		2.427	
	Number of households	39		23		16	

9.8 The spatial dominance of coconut cropping on farming systems is seen clearly in diagrams 9.1 to 9.3. Coconuts account for **70%** of the total area but are grown by only **41%** of farmers, suggesting that there are two major types of farmer in the survey area. The gardens under annual crops among tree cropping farmers tend to be simpler in terms of main crop type (table 9.2), but are no less fragmented (table 9.1) than those among non-tree crop farmers. Tree crop farmers grow less fruit and vegetables as main crops, but tend to have slightly larger root crop areas.

9.9 Table 9.2 is a simplification of cropping patterns found in the field. Table 9.3 describes in more detail the crop mixtures grown by farmers. This no longer applies to a "model" holding but, in aggregate, detailed cropping patterns may be used to determine proportional areas under crop mixtures.

9.10 Mixtures are listed hierarchically to the left of the table according to the relative dominance of each crop in the mixture. The three main crops in any mixture are listed by name and any further crops are referred to by code letters. The column of "mean plot area" records the mean area of plots measured in the field according to the number of observations shown in the next column to the right. The column on the far right is the proportional area by crop mixture.

9.11 Crop mixtures illustrate the complexity of smallholder farming systems. Small areas of vegetable and short term cash crops are typically scattered among food gardens. Tree crops are important, both within cultivated gardens and in the fallow of former gardens.

9.12 Table 9.4 summarises tree cropping. The table is in two parts, first showing the average number of trees and second the number of observations on which they are based. Each table is subdivided horizontally into cultivated garden and fallow, and vertically by garden type.

9.13 The averages in the top table are based on all plots (not only the plots in which trees are grown). In the far right column of the lower table is listed the number of observations for which trees are too numerous to count. These are excluded from the averages in the upper table.

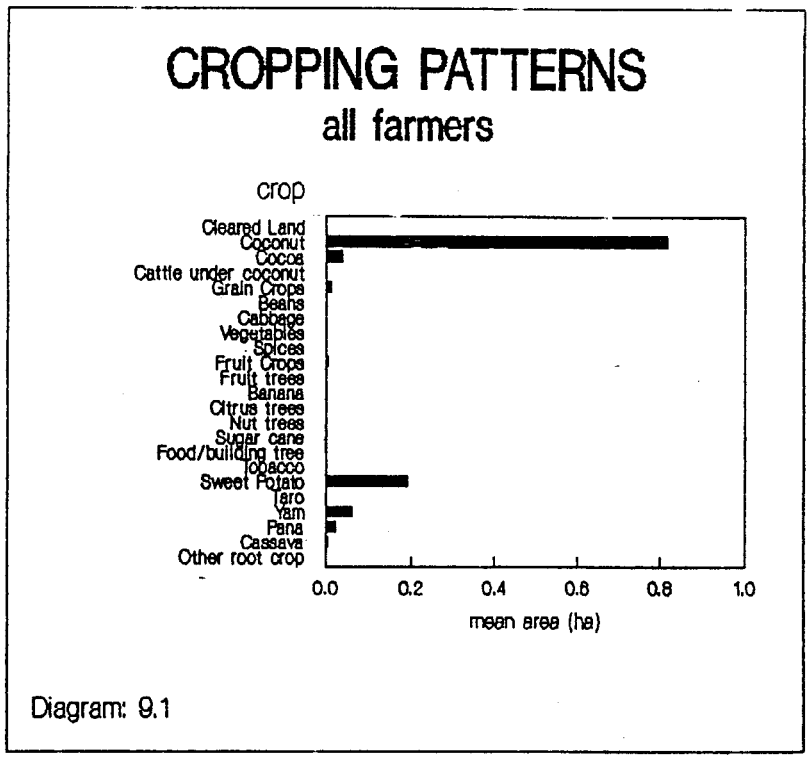

CROPPING PATTERNS
all farmers
crop
Cleared Land
Coconut
Cocoa
Cattle under coconut
Grain Crops
Beans
Cabbage
Vegetables
Spices
Fruit Crops
Fruit trees
Banana
Citrus trees
Nut trees
Sugar cane
Food/building tree
Tobacco
Sweet Potato
Taro
Yam
Pana
Cassava
Other root crop
0.0
0.2
0.4
0.6
0.8
1.0
mean area (ha)

Diagram: 9.1

CROPPING PATTERNS
farmers with no tree crops

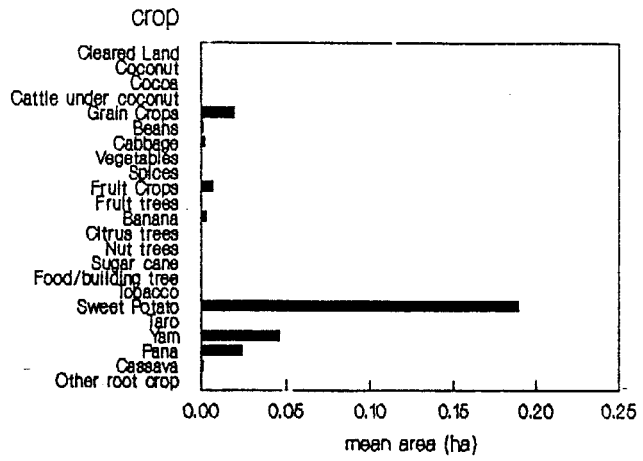


Diagram: 9.2

CROPPING PATTERNS
farmers with tree crops

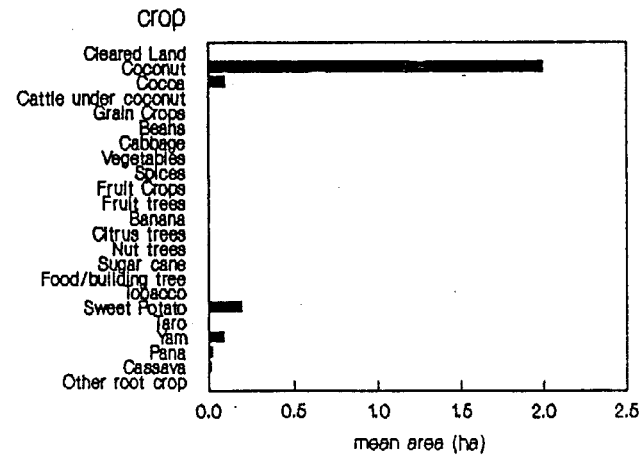


Diagram: 9.3

Table: 9.3
DETAILED CROPPING PATTERNS

crop code	main crop in mixture - crop name - first	second	third	minor mixture code	mean plot area (ha)	number of plots	% plots	% area
TOTAL					0.0638	151	100	100
a	Cleared land				0.0919	1	1	0.201
b	Coconut				1.1913	24	16	62.75
		Cocoa			1.6634	2	1	7.301
c	Cocoa				0.3786	1	1	0.830
		Coconut			1.1966	1	1	2.626
e	Grain crops				0.2214	2	1	0.971
f	Beans	Cabbage	Vegetable		0.0195	1	1	0.042
g	Cabbage	Beans	Vegetable		0.0492	1	1	0.107
j	Fruit crops				0.0823	3	2	0.542
l	Spices	Sweet Potato	Taro	j	0.0817	1	1	0.179
q	Tobacco				0.0052	1	1	0.011
r	Sweet Potato				0.0961	44	29	9.283
		Cocoa	Banana		0.1469	1	1	0.322
		Grain crops	Banana	f	0.1057	1	1	0.231
		Cabbage	Taro	v	0.1264	1	1	0.277
		Fruit crops			0.1040	4	3	0.912
		Banana	Cabbage	s	0.1198	1	1	0.262
			Sugar cane	j	0.1754	1	1	0.384
			Taro		0.0291	1	1	0.063
			Pana	vs	0.1623	1	1	0.356
		Sugar cane			0.0498	1	1	0.109
		Taro	Banana		0.0761	1	1	0.167
				v	0.0815	1	1	0.178
		Yam	Grain crops	vlho	0.1364	1	1	0.299
			Pana	el	0.0621	1	1	0.136
		Pana			0.0761	1	1	0.167
			Yam	vl	0.1706	1	1	0.374
				vs	0.2395	1	1	0.525
			Cassava	l	0.0937	1	1	0.205
				s	0.0952	1	1	0.208
		Cassava			0.1011	3	2	0.665
			Fruit crops		0.0569	1	1	0.124
				l	0.0725	1	1	0.159
			Banana		0.0566	3	2	0.372
				o	0.0910	1	1	0.199
				s	0.0484	2	1	0.212
			Taro		0.0428	1	1	0.093
				ep	0.0237	1	1	0.052
			Yam		0.0437	1	1	0.095

CROPPING PATTERNS (continued)

crop code	main crop in mixture — crop name: first	second	third	minor mixture code	mean plot area (ha)	number of plots	% plots	% area
t	Yam				0.0562	8	5	0.986
		Pana			0.1118	9	6	2.208
			Grain crops		0.3230	1	1	0.708
				j	0.0376	1	1	0.082
			Banana	v	0.1503	1	1	0.329
			Sweet Potato	j	0.1390	2	1	0.610
				sl	0.0647	1	1	0.141
			Cassava	s	0.1360	1	1	0.298
u	Pana				0.0717	1	1	0.157
		Sweet Potato			0.1262	1	1	0.276
		Yam			0.1247	3	2	0.820
			Sweet Potato	vl	0.1280	1	1	0.280
			Taro	o	0.1827	1	1	0.400
			Cassava		0.0486	1	1	0.106
v	Cassava	Banana	Taro		0.2259	1	1	0.495
		Sugar cane			0.0375	1	1	0.082

Crop Key:

a Cleared land	j Fruit crops	r Sweet potato
b Coconut	k Fruit trees	s Taro
c Cocoa	l Banana	t Yam
e Grain crops	m Citrus trees	u Pana
f Beans	n Nut trees	v Cassava
g Cabbage	o Sugar cane	w Other root crop
h Vegetable	p Food/building tree	
i Spices	q Tobacco	

Table: 9.4
TREE CROPS IN GARDENS

(---------- average number of trees per garden ----------)

crop type:	tree crops	short term cash crops	food crops	all gardens
i) In cultivated gardens:				
fruit trees	0.10		0.27	0.23
citrus				
nut trees	0.30	2.00	0.29	0.34
sweet banana			0.67	0.51
cooking banana		4.67	1.55	1.27
ii) In fallow of gardens:				
fruit trees			0.20	0.15
citrus				
nut trees		2.00	0.21	0.22
sweet banana			0.23	0.18
cooking banana			2.08	1.55

(---------- number of observations ----------)

crop type:	tree crops	short term cash crops	food crops	many but "unknown"	total
i) In cultivated gardens:					
fruit trees	21	3	81	2	107
citrus	23	3	81		107
nut trees	20	3	80	4	107
sweet banana	22	3	76	6	107
cooking banana	23	3	69	12	107
ii) In fallow of gardens:					
fruit trees	21	3	81	2	107
citrus	23	3	81		107
nut trees	20	3	80	4	107
sweet banana	23	3	81		107
cooking banana	23	3	77	4	107

9.14 Bananas, particularly cooking bananas, are an important crop, as are nut trees. Fruit trees are of lesser importance and citrus are not recorded in the sample.

Chapter: 10
COCONUT AND COCOA

10.1 Coconut and cocoa have been studied in some detail before, both in the 1974-75 Sample Survey of Agriculture [5] and in the 1985 Coconut Survey [6]. Only comparative data are therefore included in the present survey.

10.2 Copra exports from Solomon Islands started in the late 19th century, rising from **1,220 MT** in 1895 to **23,000 MT** in the '20s and '30s. Following disruption during the second world war production did not achieve pre-war levels again until the 1960s. Copra production has continued to rise since, exceeding **40,000 MT** in 1984 and 1985. Following cyclone Namu copra production fell by about 20 to 25%, but showed some recovery in 1987/88.

10.3 The structure of the copra economy has varied considerably since the start of trading. Initially a smallholder crop, the plantation sector came to dominate production from 1915 onwards. Since the 1970s smallholder production has been growing by about **4.5%** annually and smallholder copra production now accounts for around **70%** of the total [8].

10.4 The area under smallholder coconuts has expanded considerably over the past 15 years, in part due to a subsidy scheme operating from 1968 to 1978 which was designed to encourage the rehabilitation, planting and replanting of coconut palms. Consequently the age structure of smallholder palms is young, with almost half the palms planted since 1970 and nearly **90%** planted since the war [8].

10.5 The total number of coconut palms in Solomon Islands is estimated to be around **9 million**, covering an area of approximately **60,000 hectares**. Table 10.1 shows the provincial breakdown of copra production, in which Western, Guadalcanal, Malaita and Central Provinces account for about **80%** of production.

10.6 The mean national copra yield is 0.72 MT per hectare according to the 1985 Coconut Survey [7]. The 1974-75 Sample Survey of Agriculture found that the average number of coconuts per palm was **36** (30 in the 1985 Coconut Survey) and assumes an average whole nut weight of **1.2kgs** with **190gm** dried copra equivalent per nut. Disciplined plantings were found to yield **40%** more per tree than customary plantings, but only **7%** more per unit area because of the greater density of customary planted trees. This result was was questioned in the 1985 Survey.

Table: 10.1
COPRA AREA AND PRODUCTION BY PROVINCE (1984)

Province	area (ha)	%	production (MT)	%	yield (MT/ha)	number of palms
Western	14,454	25	13,816	32	0.96	2,093,795
Ysabel	5,230	9	2,969	7	0.57	817,555
Central	7,909	13	9,073	21	1.15	1,287,680
Guadalcanal	12,758	22	7,324	17	0.57	1,824,790
Malaita	11,890	20	5,575	13	0.47	1,980,595
Makira	3,555	6	2,662	6	0.75	540,810
Temotu	3,032	5	1,167	3	0.38	494,420
Total	58,918	100	42,586	100	0.72	9,039,645

Source: Statistics Office, Solomon Islands (1986), Statistical Bulletin 18/86

10.7 The yield from well maintained plantations was found to be higher than from poorly maintained plantations, but the 1985 Coconut Survey attributed this to more intensive harvesting rather than the productivity of palms (5).

10.8 In the 1985 Coconut Survey soil type was classified into three broad categories. **41%** of plots lay on sand or coral; **47%** on black alluvial soils; and **21%** on red clay. It was concluded that the reason for low yields is often area specific but soil nutrient deficiency, notably potassium, is an important factor. Despite this, and high copra prices at the time, the 1974-75 survey found that "fertilizer is only applied when provided under some sort of subsidy scheme" and that "smallholder farmers will not buy fertilizer to use on their own plots. There is generally a lack of understanding of the use of fertilizer by farmers, and in many cases a reluctance to use it even when it is provided at a subsidised price" (5).

10.9 Other important factors identified in the 1985 Coconut Survey as affecting production were pests and disease. Over half the plots sampled in the 1985 suffered from Leaf Spot, which may refer to the symptoms of pest infestation or nutrient deficiency. One quarter of plots showed some evidence of White Thread, but it was felt that neither problem significantly affected output. About 40 ot 50 percent of plots were felt to be disease free (7).

10.10 Amblypelta cocophaga appeared to be a significant pest in parts of Western province, the Floridas, Guadalcanal and Malaita. 38% of households reported premature nutfall which is linked to Amblypelta in certain localities. Brontispa spp was also evident, and minor pests included rhinoceros beetle (Scapanes australis), rats, cockatoos, flying foxes and others[7].

10.11 Table 10.2 presents additional results from the present study. Almost all coconut and cocoa is pure stand, although there is some intercropping of coconut and cocoa.

Table: 10.2
COCONUTS AND COCOA

	% plots		
	coconut	cocoa	coconut + cocoa
i) Intercropping:			
Pure stand	96	100	
Intercropping with:			
Coconut + cocoa			100
Short term cash crops			
Food crops	4		
Livestock			
Total %	100	100	100
Number of observations (plots)	24	1	3
ii) Maintenance:			
Undercropped	4		
Brushed to ground level	29	100	67
Brushed to shoulder height	42		
Secondary bush	25		33
Burnt			
Total %	100	100	100
Number of plots	24	1	3
iii) Coconut variety composition			
Tall	95		100
Rennel	5		
Dwarf			
Other			
Total %	100		100
Number of plots	24		3

iv) Coconut age composition

< 8 years	17	
9 - 16 years	23	
17 - 40 years	58	100
> 40 years senescent	3	
Total %	100	100
Number of plots	24	3

v) Cocoa age composition

< 3 years		
3 - 5 years		50
6 - 25 years	100	50
> 25 years		
Total %	100	100
Number of plots	1	3

vi) Cocoa shade

coconuts planted shade	100	33
natural shade planted and natural		67
Total %	100	100
Number of plots	1	3

10.12 The coconut survey of 1985 found that the average spacing of 7.5metres for palms was not significantly different between triangular and square planted plots. On customary plantings there was a wide variation in planting density, but the majority of plots were similar to disciplined plantings (7).

10.13 The 1974-75 sample survey of agriculture found that more than half of all immature palms were well maintained. Among bearing trees more than 60% of disciplined plantings were well maintained compared to 47% of customary planted palms (5). The 1985 coconut survey found lower management standards, and that even with 30% of farmers hiring workers to assist with maintenance only 39% of plots were well brushed. 47% revealed weed growth to shoulder height, and 13% of plots were totally neglected (7). The relationship between levels of maintenance, yield and soil conditions was not established in the 1985 survey.

10.14 Maintenance levels from the present survey, summarised in table 10.2, broadly coincide with the findings of the 1985 coconut survey. 25% of coconut plots and 33% (only one observation) of coconut intercropped with cocoa plots have reverted to secondary bush. Such plots are often brushed again and brought back into production, but their current productivity is low. Maintenance levels are illustrated in diagram 10.1.

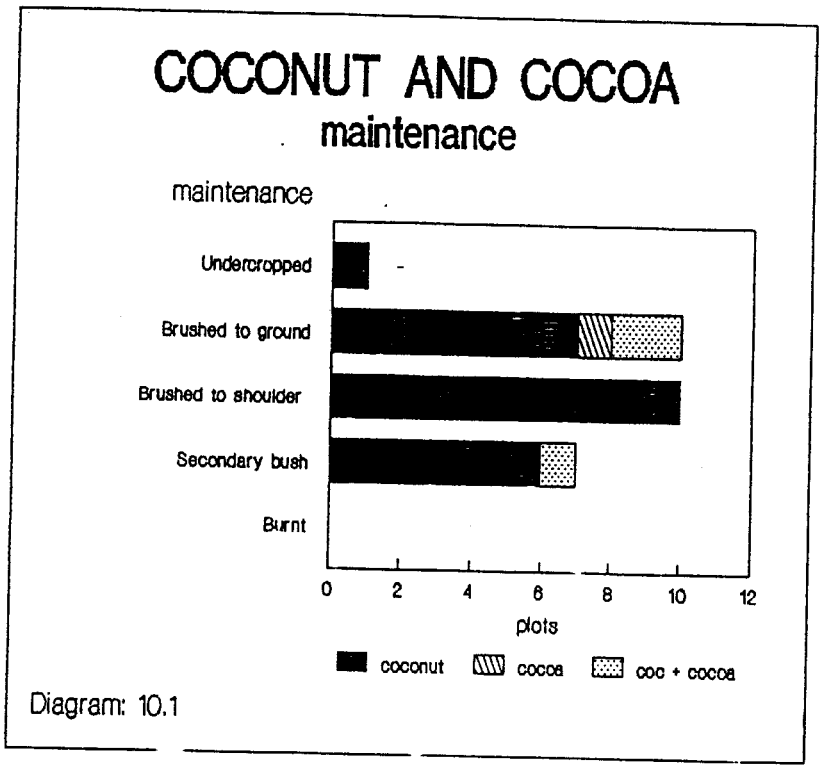


Diagram: 10.1

10.15 In the survey area coconut varieties are almost entirely local tall. **40%** are less than 16 years of age, **17%** are pre-bearing age but few if any are beyond bearing.

10.16 There are few cocoa observations, but all are of bearing age, with a mixture of coconut or other types of shade.

Chapter: 11
FALLOW

11.1 Throughout Solomon Islands almost all gardens are cultivated according to a form of shifting cultivation with bush fallow. In the 1974-75 Sample Survey of Agriculture it was found that, where population density or land tenure problems have restricted the availability of suitable land, the length of fallow may be reduced from the optimum 7 to 20 years to as little as one or two years. In such areas soil fertility becomes depleted through over frequent cropping[5].

11.2 Research in Solomon Islands has shown that soils are low to very low in potassium. The geology of the country is composed in the main of rocks which are low in potassium minerals, and potassium is readily leached from soil under conditions of continuously high rainfall and rugged topography. Fallow is essential for the restoration of potassium fertility: "Under traditional shifting cultivation the depletion of potassium by crops is gradually reversed over a period of 3-15 years or more by a combination of mineral weathering and root systems incorporating potash in the nutrient cycle". Although burning leads to an erratic distribution of potassium in the topsoil, "the burning of vegetative trash is beneficial and it has been shown that topsoil potassium is increased by as much as 100% on average after burning, all of this increase being held by the exchange complex"[9].

11.3 Research on Malaita has shown that the average tuber yield of sweet potato is **9.3t/ha** on sites of more than 10 years of fallow, falling off rapidly to **6.0t/ha** on land of 5 - 9 years of fallow; **4.8t/ha** on land of 0 - 4 years of fallow; and **3.5t/ha** on successively cropped land. A residual yield of 2 - 6t/ha "seems to represent the rate of release of potassium from slowly available reserves in soil and weathering parent material within rooting depth". Large amounts of fertiliser are required to restore yields. A supply of 112kg/ha K is only marginally beneficial and inadequate to replenish the rate of potassium removal by the crop. 200 to 300kg/ha K is said to be required to restore yields to levels commensurate with long fallow periods[9].

11.4 Phosphorus varies widely in its total and available forms, but Solomon Islands soils generally have low levels in the subsoil and medium levels of total phosphorus in the topsoil. Most soils used for agriculture have satisfactory levels of phosphorus but as land pressure increases deficiencies may become more widespread. Humus in the topsoil is accompanied by an increase in phosphorus, mainly in organic form, which may become readily available (9).

11.5 Soil total nitrogen levels are generally adequate, with C:N ratios in the range 7-13 signifying the ready availability of nitrogen. Topsoil nitrogen is dependent on land use and in particular the length of fallow since there is a build-up of topsoil nitrogen under secondary regrowth. Sulphur is similarly associated with organic matter, and is higher under forest than under burned grassland (9).

11.6 There is a close relationship between pH and organic matter. The lower the pH the greater the surface organic matter and the higher the subsoil organic carbon content. Difficulties associated with low pH such as aluminium toxicity are only likely to be widespread in the New Georgia group and possibly Ysabel. Alkaline soils are fairly widespread and are associated with reef limestone. The chief problem induced by alkaline calcareous soils is lime induced chlorosis of foliage which results from deficiencies of iron, manganese, zinc and copper (9).

11.7 In addition there is a close relationship between soil depth and soil fertility. "All stable sites tend to favour an accumulation of maximum weathered material due to minimal losses by surface erosion. Thus there arises the paradox that on stable hill sites and terraces the soils tend to be deepest but least fertile, while on adjacent steep slopes the soils are relatively unweathered, and hence fertile, but shallow" (9).

11.8 The shifting system of smallholder agriculture in Solomon Islands is suited to the environment and prevailing management. Soil fertility is restored during fallow periods, and small isolated areas of mixed cropping are not conducive to pest build-up. Burning of surface vegetative trash not only releases a flush of nutrients, of which the most important is potassium, but is also a useful phytosanitary measure which destroys weed seeds, some insects and undesirable pathogens (9).

11.9 An analysis of fallow therefore tells much about the dynamics of smallholder agriculture, and likely pressures on farming systems. Hansell and Wall[10] state that "there is little doubt that the major factor influencing the decision to abandon the garden is the decline in crop productivity but the exact causes of the decline are not fully understood". The greatest decline in production is between the first and second crops, rather than between the second and subsequent crops. They estimate that despite reduced yields there is still a good return from a low input of labour and conclude that reduced yields alone is insufficient reason for the abandonment of a garden. An important consideration may be the build-up of soil-borne plant diseases causing the rotting of corms or tubers, insect attack and weed infestation[10].

11.10 In the 1974-75 Sample Survey of Agriculture[5] it was stated that, while in overall terms Solomon Islands cannot be said to be suffering from land pressure, it may occur in some areas. Table 11.1 shows the distribution of garden land by the length of the bush fallow in 1975.

Table: 11.1
LENGTH OF BUSH FALLOW (1975)

length of bush fallow (years)	Western	Ysabel Central Guadalcanal	Malaita	Makira Temotu	Solomon Islands
		% observations			
< 2	23	6	17	16	14
2 - 4	20	5	33	14	18
5 - 7	4	11	25	12	15
8 - 10	10	10	8	15	10
> 10	13	20	3	14	13
never previously cultivated	29	48	15	29	32
Mean length fallow (years)	5.6	9.2	4.5	6.7	6.4

Source: Statistics Office (1978), 1974-75 Agricultural Statistics Survey

11.11 Table 11.2, also from the 1974-75 survey, shows the distribution of garden land by length of cultivation.

Table: 11.2
LENGTH OF CULTIVATION (1975)

length of cultivation (months)	Western	Ysabel Central Guadalcanal	Malaita	Makira Temotu	Solomon Islands
		% observations			
< 4	20	45	11	19	27
4 - 6	62	31	36	22	37
7 - 9	12	13	25	33	19
10 - 12	5	8	14	18	10
> 12	2	4	14	8	7
Mean cultivation (months)	5.1	4.7	7.6	7.2	6.0

Source: Statistics Office (1978), 1974-75 Agricultural Statistics Survey

11.12 In 1975 it was found that **32%** of gardens in Solomon islands had never been previously cultivated, and that the average length of bush fallow of cultivated gardens was **6.4** years. Only **7%** of gardens were generally cultivated for more than 12 months before reverting to fallow, and the average length of cultivation of food gardens was **6** months.

11.13 Table 11.3 summarises cropping intensity in the survey area. The crop period is shown in the first column, which is the time from planting to harvest for the named crop.

11.14 The second column describes the number of times an area is cropped in sequence before reverting to fallow. This introduces complexity since the crop type may, and commonly does, change within the sequence. Thus yam will commonly be followed by sweet potato, which may be followed later by cassava. The table therefore shows different stages in the cropping sequence. Since there are 79 sweet potato observations compared with 32 yam and pana observations, the main root cropping sequence is:

yam/pana 8 months
sweet potato 4 months
sweet potato 4 months
cropped once again or abandoned

Table: 11.3
CROPPING INTENSITY

crop type		harvest to harvest (months)	number of crops in sequence	number of cases (obs)
all crops		5.5	3.4	151
cleared land	a			1
coconut	b	7.4	na	26
cocoa	c	3.3	na	2
grain crops	e	3.0	3.5	2
beans	f	3.0	3.0	1
cabbage	g	4.0	8.0	1
fruit crops	j	9.0	2.7	3
banana	l	2.0	3.0	1
tobacco	q		1.0	1
sweet potato	r	4.0	3.7	79
yam	t	7.3	3.3	34
pana	u	8.4	3.9	8
cassava	v	9.0	3.5	2

Note: "na" = not applicable

11.15 Table 11.4 describes the fallow period, however, this has little meaning for tree crops since the interpretation of fallow varies with the age of the tree crop and previous cropping history. For food crops the fallow period relies on the knowledge of the respondent. Often it is found that long fallow periods are beyond the memory of operators and these are referred to as "cases longer than memory". 50% of gardens have such long fallows. Where the fallow period is known on food gardens there are 5.6 years of fallow between cropping.

Table: 11.4
FALLOW PERIOD (years)

crop type:	tree crops	short term cash crops	food crops	all crops
mean years of fallow	na		5.6	5.4
standard deviation	na		5.4	6.0
number of cases	10		44	54
cases longer than memory				53
total cases				107

11.16 Fallow periods cover a range of soil and site conditions, and are themselves variable. Table 11.5 shows that **46%** of fallow periods on food gardens are longer than memory (and **57%** on tree crop gardens). Some intensive cropping does take place, but fallow periods are generally long.

Table: 11.5
FALLOW RANGE

i) Fallow Range by number of observations (gardens)

crop type:	tree crops	short term cash crops	food crops	all crops
no fallow	7		1	8
1 year			13	13
2 years			2	2
3 years	1		4	5
4 years			3	3
5 years			5	5
6 - 10 years			7	7
11 - 20 years	2		9	11
21 - 50 years				
beyond memory ("long time")	13	3	37	53
total by crop type	23	3	81	107

ii) Fallow Range by % area of holding

crop type:	tree crops	short term cash crops	food crops	all crops
no fallow	30			30
1 year			2	2
2 years				
3 years	2			2
4 years				
5 years			2	2
6 - 10 years			2	2
11 - 20 years	4		4	9
21 - 50 years				
beyond memory ("long time")	37		15	52
total by crop type	74		26	100

Note: The table of % area is only approximate due to rounding small numbers

11.17 That fallow periods are long can be seen in the type of fallow, shown in table 11.6.

Table: 11.6
FALLOW TYPE

i) Fallow type by number of observations (gardens)

crop type:	tree crops	short term cash crops	food crops	all crops
primary forest	9	1	9	19
secondary forest	7	2	44	53
dense thicket	2		19	21
open scrub grassland			1	1
grassland			6	6
planted fallow			1	1
other fallow	5		1	6
total by crop type	23	3	81	107

ii) Fallow type by % area of holding

crop type:	tree crops	short term cash crops	food crops	all crops
primary forest	34		2	36
secondary forest	14		16	30
dense thicket	5		7	11
open scrub grassland				
grassland				
planted fallow				
other fallow	23			23
total by crop type	75		25	100

Note: The table of % area is only approximate due to rounding small numbers

11.18 **67%** of all gardens have a fallow of primary or secondary forest, with a further **20%** under dense shrubby thicket - in total accounting for **77%** of the cropped area. Land pressure at present is relatively low around Marau Sound.

11.19 **8%** of the food garden area is cut from primary forest compared with **45%** of the tree area. Tree areas are static whereas annual cropping is constantly shifting so that the fallow area of food gardens is relatively large with respect to the area cultivated to annual crops. Thus the encroachment of food gardens into primary forest is correspondingly large, since all fallow was originally primary forest.

Chapter: 12
LANDFORM

12.1 The survey area, among the eastern coastal lands and islands of Guadalcanal, is populated mainly along the coastal belt. Landforms are broadly subdivided into "lowland" and "upland" where "upland" simply means above the coastal plain or coastal terrace, but does not imply high elevation.

12.2 Table 12.1 shows the distribution of cultivated land in the survey by landform. The first part of the table records the number of observations (gardens) and is expressed in area terms in the second part of the table.

12.3 **78%** of coconut gardens representing **83%** of the coconut area are on beach sites or lowland plains. **22%** of coconut gardens representing **17%** of the coconut area are on upland sites, on slopes of varying steepness, and some on very steep sites.

12.4 The majority of food crop gardens are on upland sites. **57%** of food crop gardens representing **61%** of the food garden area are on upland, mostly steeply sloping, sites. **43%** of gardens representing **39%** of food garden area are on lowland plains.

12.5 A summary of the association between croping and landform is illustrated in diagram 12.1.

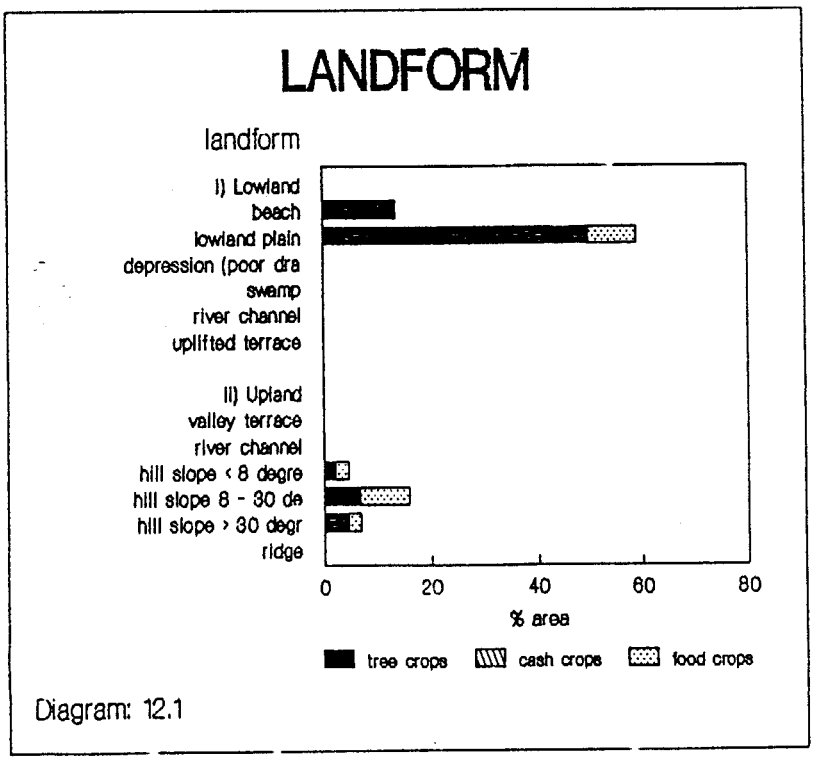


Diagram: 12.1

Table: 12.1
LANDFORM

i) Landform by number of observations (gardens)

crop type:	tree crops	short term cash crops	food crops	all crops
i) Lowland				
beach	3		2	5
lowland plain	15	3	33	51
depression (poor drainage)				
swamp				
river channel				
uplifted terrace				
ii) Upland				
valley terrace				
river channel			3	3
hill slope < 8 degrees	1		7	8
hill slope 8 - 30 degrees	3		25	28
hill slope > 30 degrees	1		10	11
ridge			1	1
total by crop type	23	3	81	107

ii) Landform by % area of holding

crop type:	tree crops	short term cash crops	food crops	all crops
i) Lowland				
beach	14			14
lowland plain	50		9	59
depression (poor drainage)				
swamp				
river channel				
uplifted terrace				
ii) Upland				
valley terrace				
river channel				
hill slope < 8 degrees	2		2	5
hill slope 8 - 30 degrees	7		9	16
hill slope > 30 degrees	5		2	7
ridge				
total by crop type	77		23	100

Note: The table of % area is only approximate due to rounding small numbers

12.6 Table 12.2 describes the characteristics of slope in farming systems. The first part of the table records the frequency of observations (plots) which is expressed in area terms in the second part of the table.

12.7 The overall mean slope among all plots is **10** degrees. 82 plots or **54%** of all plots, representing **73%** of the total cultivated area, are on sites of less than 5 degrees slope. The remainder range from 5 degrees to over 30 degrees.

12.8 Coconuts and cocoa are mostly on level sites, with a mean slope of 7 degrees for coconuts.

12.9 Food plots are also predominantly on level or gently sloping sites, but many are on steep sites. The mean slope of sweet potato plots is **10** degrees. **58%** of sweet potato plots (46 plots), representing **50%** of the sweet potato area, are on sites of less than 5 degrees of slope. The remainder range from 5 to over 30 degrees of slope.

12.10 Yam plots have a mean slope of **19** degrees. **38%** of yam plots (9 plots), representing **50%** of the yam area, are on slopes of less than 10 degrees. Many small plots are on steep sites, but yams are mostly on sites of 10 to 20 degrees.

12.11 The area cultivated to pana is very small. The mean slope of pana plots is **14** degrees, with **13%** of pana plots on slopes of greater than 20 degrees.

12.12 Fruit and vegetable crops, representing a small proportion of the total cultivated area, are on flat to gently sloping sites of less than 10 degrees slope.

Table: 12.2
SLOPE

i) Slope by number of observations (plots)

crop type		mean slope (degrees)	frequency of plots at different degrees of slope						frequenc of crops
			0 - 5 degrees	5 - 10 degrees	10 - 20 degrees	20 - 30 degrees	30 - 50 degrees	› 50 degrees	
all crops (total)		10	82	20	22	10	16	1	151
cleared land	a	12			1				1
coconut	b	7	20		3		3		26
cocoa	c	0	2						2
grain crops	e	0	2						2
beans	f	8		1					1
cabbage	g	0	1						1
fruit crops	j	4	2	1					3
banana	l	0	1						1
tobacco	q	7		1					1
sweet potato	r	10	46	10	8	7	8		79
yam	t	19	3	6	7	3	4	1	24
pana	u	14	3	1	3		1		8
cassava	v	0	2						2

ii) Slope by % area of holding

crop type		% total cultivated area						
		0 - 5 degrees	5 - 10 degrees	10 - 20 degrees	20 - 30 degrees	30 - 50 degrees	› 50 degrees	all slopes
all crops (total)		73	5	11	2	9		100
cleared land	a							
coconut	b	59		7		7		73
cocoa	c	5						5
grain crops	e							
beans	f							
cabbage	g							
fruit crops	j							
banana	l							
tobacco	q							
sweet potato	r	9	2	2	2	2		18
yam	t		2	2				5
pana	u							
cassava	v							

Note: The table of % area is only approximate due to rounding small numbers

12.13 Table 12.3 summarises conservation measures. There is only one occurrence of contour cultivation, in which alley cropping was practiced in a food garden. In general there are no conservation measures practiced. In the survey area fertility is maintained by long fallow periods and there is no visible evidence of erosion due to cropping.

Table: 12.3
CONSERVATION AND ALLEY CROPPING

i) Conservation by number of observations (gardens)

crop type:	tree crops	short term cash crops	food crops	all crops
i) Conservation				
none	23	3	80	106
contour cultivation			1	1
bunding				
terracing				
ii) Alley cropping				
not performed	23	3	80	106
performed			1	1
total by crop type	23	3	81	107

ii) Conservation by % area of holding

crop type:	tree crops	short term cash crops	food crops	all crops
i) Conservation				
none	75		25	100
contour cultivation				
bunding				
terracing				
ii) Alley cropping				
not performed	75		25	100
performed				
total by crop type	75		25	100

Note: The table of % area is only approximate due to rounding small numbers

12.14 A further aspect of "landform" is the spatial distribution of gardens. Diagrams 12.2 to 12.5 illustrate the relationships between crop type, crop area and the distance of gardens from households.

2.15 Diagram 12.2 is the graph of gardens for all crops, while subsequent diagrams show the distance relationships for the major crop types. The graph shows the relationship between garden area (vertical axis) and the time taken to reach the garden from the household (horizontal axis). Graph entries represent the number of observations (gardens) and are numbered from 1 to 9 and thereafter alphabetically. Thus where points coincide the number of points is shown: 9 occurrences is recorded as "9"; 10 occurrences as "A"; 13 occurrences as "D"; and so on.

12.16 The overall mean time taken to reach gardens is .216 hours, or about 13 minutes, with a maximum time recorded as 1.40 hours. There is no discernable trend in diagram 12.2.

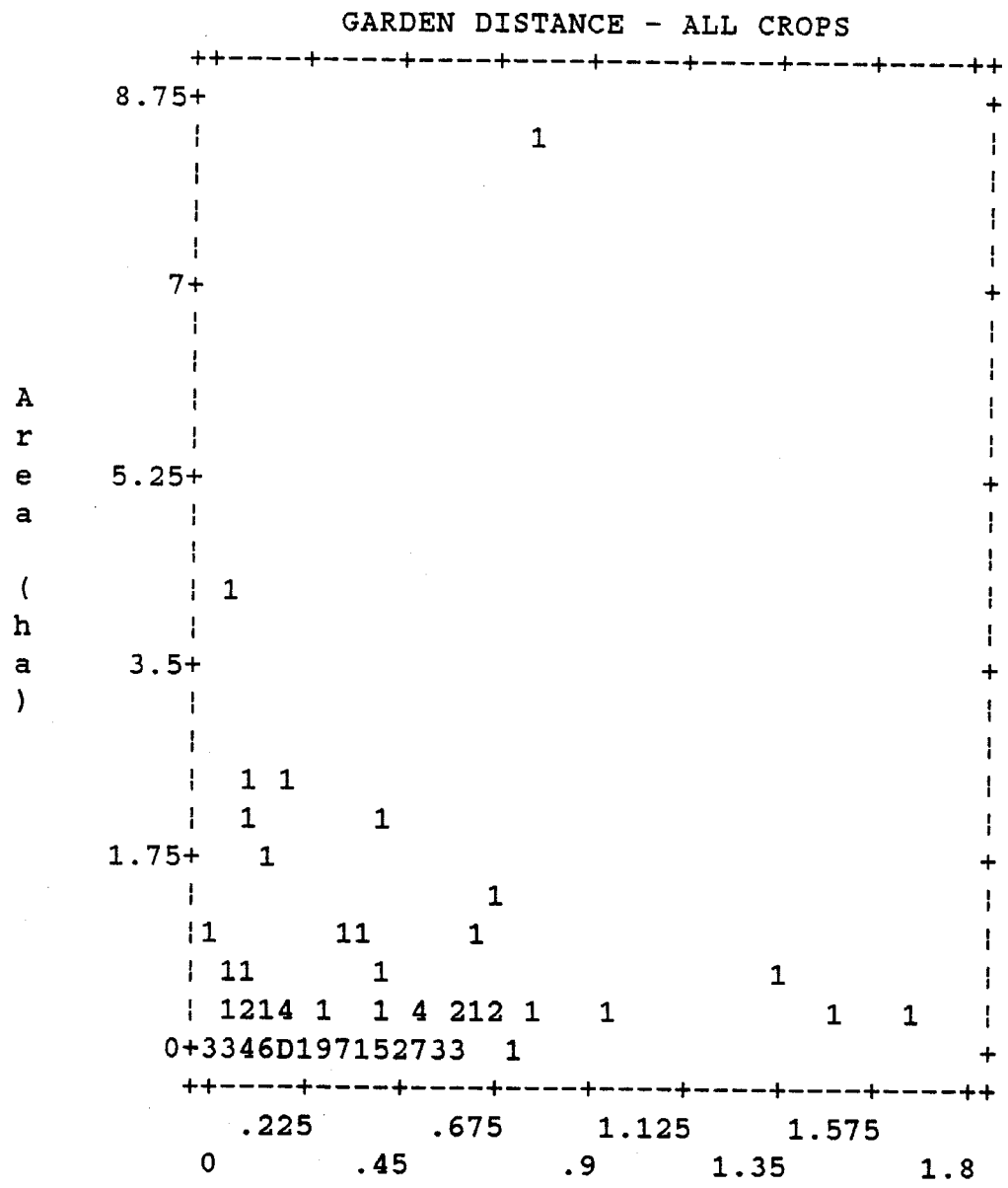
12.17 Diagram 12.3 shows the same information, but this time for tree crop gardens. The mean time taken to reach tree crop gardens from the household is .229 hours, with a maximum recorded time of 1.40hrs. Larger gardens tend to be closest to the house.

12.18 There are few observations on short term cash crops, shown in diagram 12.4. Gardens are small areas close to households, with a mean time to reach gardens of .217 hours, and a maximum of .30 hours.

12.19 For food crops the trend in diagram 12.5 is positive, indicating that the larger gardens tend to be furthest away. The mean time taken to reach food gardens from the household is .212 hours, with a maximum time of 1.30 hours.

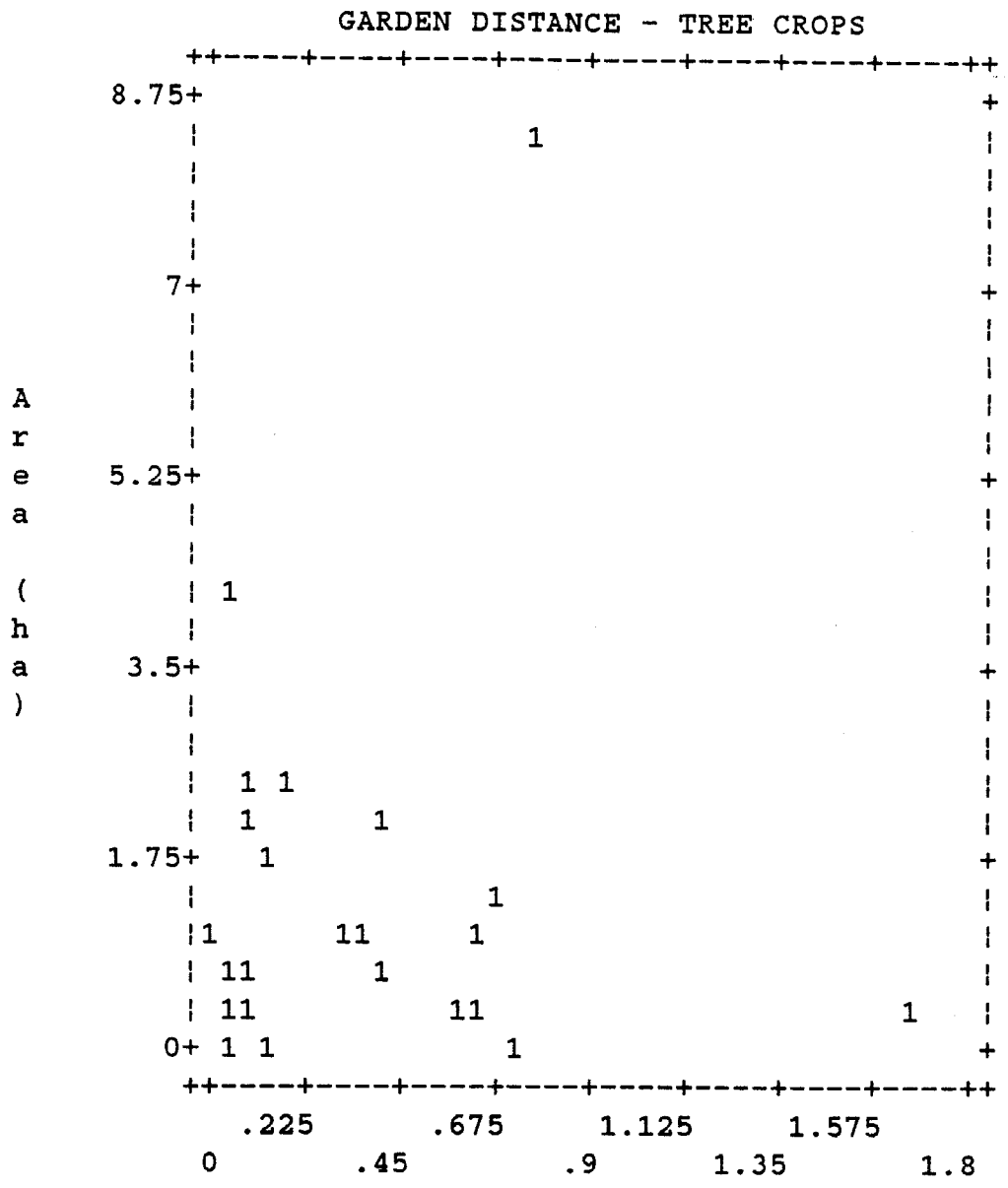
12.20 The distance distributions of tree cropping and food gardens are similar and there is no evidence in Marau Sound that cash cropping has pushed food gardens onto distant sites.

Diagram: 12.2



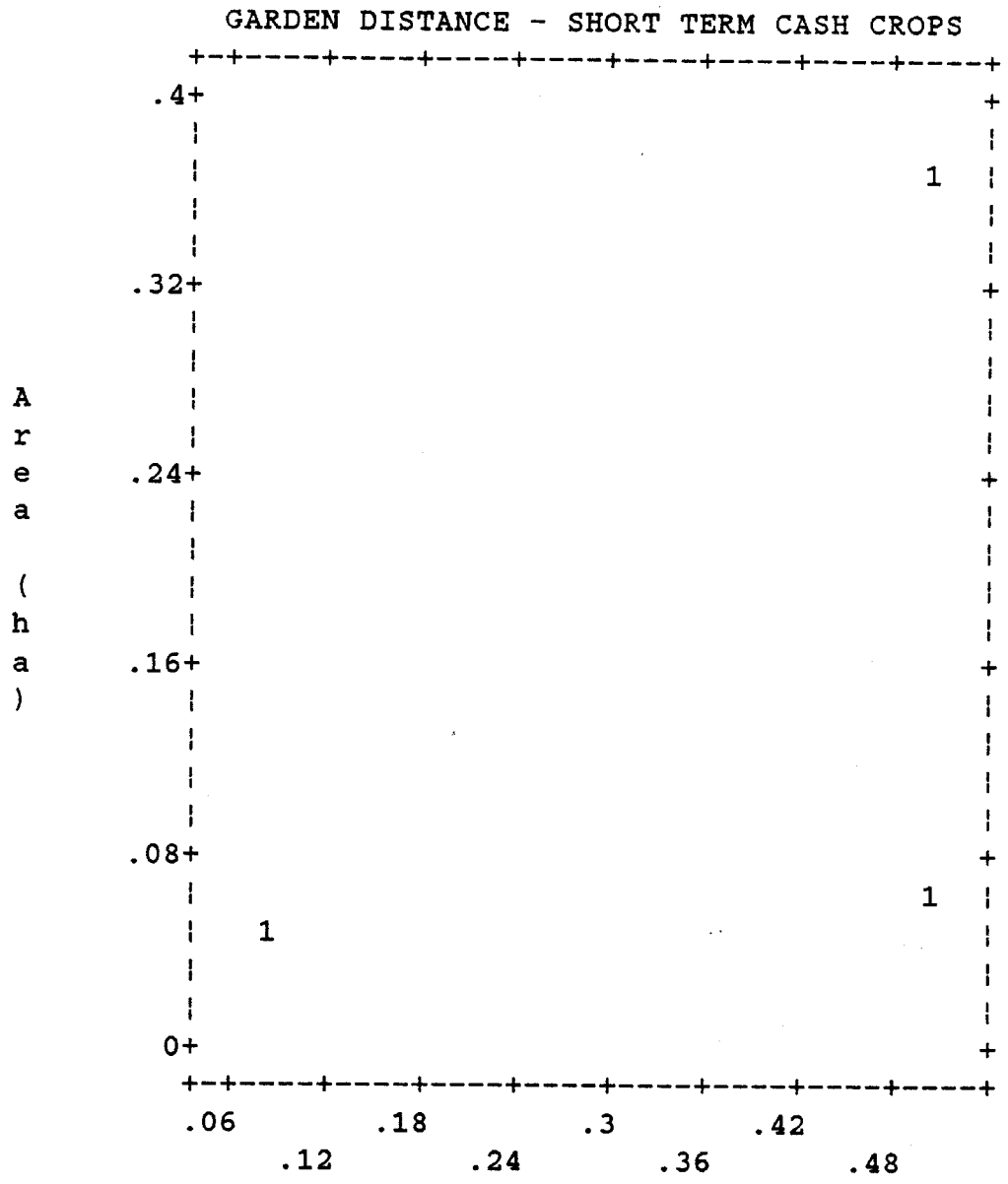
Mean = .216 hrs
Max = 1.40 hrs
Number of observations (gardens) = 107

Diagram: 12.3



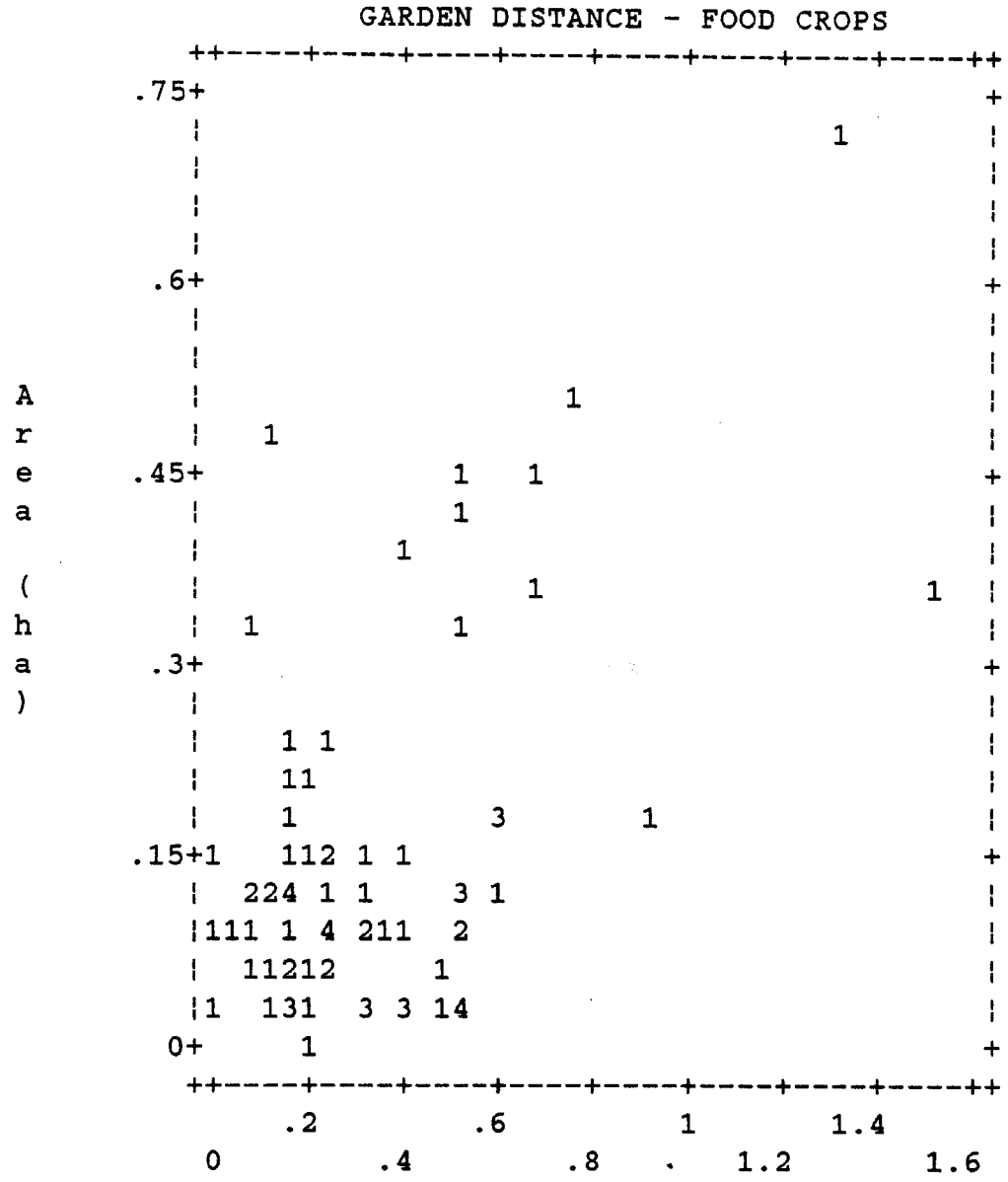
Mean = .229 hrs
Max = 1.40 hrs
Number of observations (gardens) = 23

Diagram: 12.4



Mean = .217 hrs
Max = .300 hrs
Number of observations (gardens) = 3

Diagram: 12.5



Mean = .212 hrs
Max = 1.30 hrs
Number of observations (gardens) = 81

Chapter: 13
ADVERSE FACTORS AFFECTING PRODUCTION

13.1 Table 13.1 describes site factors which farmers regard as problems. The first part of the table specifies the number of observations (gardens), which is expressed as the proportion of cultivated area affected in the second part of the table.

Table: 13.1
SITE CONDITIONS

i) Site Conditions by number of observations (gardens)

crop type:	tree crops	short term cash crops	food crops	all crops
no site limitation	8	2	68	78
poor soil/site	2		2	4
pest/disease problem	1	1	6	8
poor site + pests				
weed problem	7		3	10
weeds + poor site	3		1	4
weeds + pests	2		1	3
weeds + site + pests				
total by crop type	23	3	81	107

ii) Site Conditions by % cultivated area affected

crop type:	tree crops	short term cash crops	food crops	all crops
no site limitation	27		22	49
poor soil/site	4			4
pest/disease problem	2		2	4
poor site + pests				
weed problem	27			27
weeds + poor site	9			9
weeds + pests	7			7
weeds + site + pests				
total by crop type	76		24	100

Note: The table of % area is only approximate due to rounding small numbers

13.2 73% of all gardens (78 gardens) but representing only 49% of the cultivated area have no site limitations. Thus problems are encountered on 51% of the cultivated area. Site problems may be summarised by grouping the main factors as follows:

	% gardens	% area
No site limitations	73	49
Poor soil/site	7	13
Pests/disease	10	11
Weeds	16	43

13.3 The major problem is weeds affecting 43% of the cultivated area, although poor soils and pests and disease are also important. Site conditions are illustrated in diagram 13.1 showing that tree crop management encounters major problems, of which weeds are dominant, but also poor soil and pest and disease problems affect large areas. 78% of tree crop plantings are affected by problems on 90% of the tree crop area.

13.4 In contrast food crops show relatively few problems, affecting 16% of food gardens but only 8% of the food crop area.

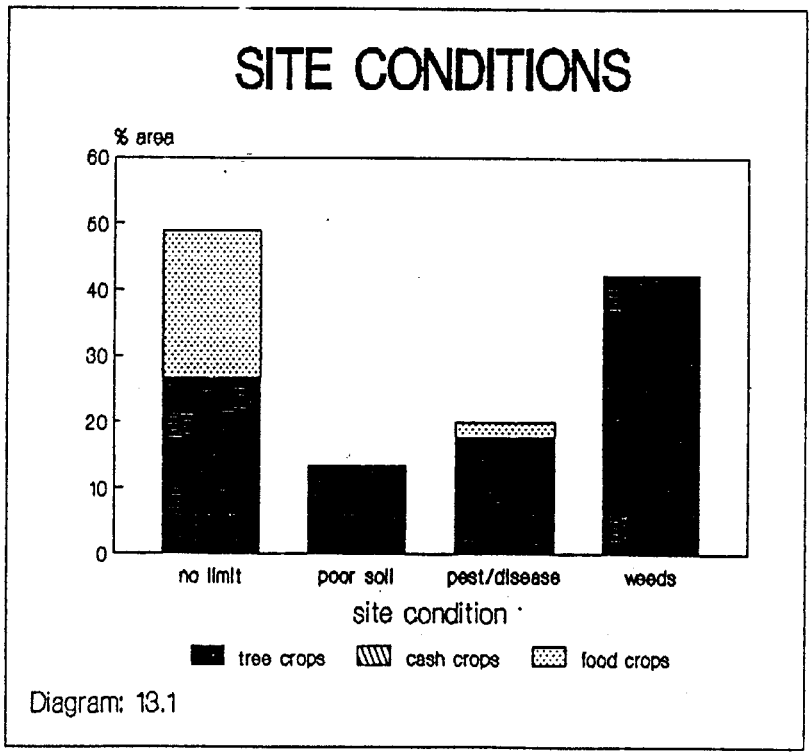


Diagram: 13.1

13.5 Table 13.2 describes physical crop damage. **45%** of coconut stands are said to be affected by cyclone damage (historic and recent) extending over **40%** of the coconut area. **21%** of food crop gardens are affected by other factors, extending over 20% of the food garden area.

Table: 13.2
PHYSICAL CROP DAMAGE

i) Crop Damage by number of observations (gardens)

crop type:	tree crops	short term cash crops	food crops	all crops
no damage	13	3	64	80
cyclone damage	10			10
other damage			17	17
cyclone and other damage				
total by crop type	23	3	81	107

ii) Crop Damage by % cultivated area affected

crop type:	tree crops	short term cash crops	food crops	all crops
no damage	45		20	66
cyclone damage	30			30
other damage			5	5
cyclone and other damage				
total by crop type	75		25	100

Note: The table of % area is only approximate due to rounding small numbers

13.6 Table 13.3 describes insect damage to crops. The first part of the table shows the frequency of plots on which damage was encountered, and is expressed in area terms in the second part of the table. The nature of damage is described (in three main columns) by the part of the crop affected: leaves, fruits or roots - each subdivided into severity of damage observed on the standing crop. To the right of the upper table, "frequency of plots" shows the total number of plots observed, including those for which there is no damage. The first row of each table summarises damage across all crops.

Table: 13.3

INSECT CROP DAMAGE

i) Insect Damage by frequency of damage encountered (plots)

part of crop affected:		leaves		fruits		roots		frequency of plots
extent of damage:		little	consi-derable	little	consi-derable	little	consi-derable	
all crops (total)		12	3	11	12	12	12	151
cleared land	a							1
coconut	b	6		5	4			26
cocoa	c							2
grain crops	e							2
beans	f	1		1				1
cabbage	g		2					1
fruit crops	j							3
banana	l							1
tobacco	q							1
sweet potato	r	4	1			12	11	79
yam	t							24
pana	u							8
cassava	v	1					1	2

Note: "Roots" on root crops refers to tubers

ii) Insect Damage by % cultivated area affected

part of crop affected:		leaves		fruits		roots	
extent of damage:		little	consi-derable	little	consi-derable	little	consi-derable
all crops (total)		16		9	11	4	
cleared land	a						
coconut	b	16		9	9		
cocoa	c						
grain crops	e						
beans	f						
cabbage	g						
fruit crops	j						
banana	l						
tobacco	q						
sweet potato	r					4	
yam	t						
pana	u						
cassava	v						

Note: The table of % area is only approximate due to rounding small numbers

13.7 The most extensive damage is to sweet potato tubers, in which **14%** of sweet potato plots (11 plots) are considerably damaged while a further **15%** if plots (12 plots) show slight damage. **15%** if coconut plots (4 plots) show considerable damage to the nuts while a further **19%** of plots show slight damage. On the minor crops there may also be severe insect problems, forinstance on the only plot where beans is the main crop there is insect damage to both the pods (fruits) and to the leaves.

13.8 Table 13.4 is the corresponding table for disease damage.

Table: 13.4
DISEASE CROP DAMAGE

i) Disease Damage by frequency of damage encountered (plots)

part of crop affected:		leaves			fruits		roots	frequency
extent of damage:		little	consi-derable	severe	little	consi-derable	little	of plots
all crops (total)		3	5	1	4	1	6	151
cleared land	a							1
coconut	b		2		4	1		26
cocoa	c							2
grain crops	e							2
beans	f							1
cabbage	g							1
fruit crops	j							3
banana	l							1
tobacco	q							1
sweet potato	r	2	2	1			2	79
yam	t		1				1	24
pana	u						1	8
cassava	v	1					2	2

ii) Disease Damage by % cultivated area affected

part of crop affected:		leaves			fruits		roots
extent of damage:		little	consi-derable	severe	little	consi-derable	little
all crops (total)			7		9		
cleared land	a						
coconut	b		7		9		
cocoa	c						
grain crops	e						
beans	f						
cabbage	g						
fruit crops	j						
banana	l						
tobacco	q						
sweet potato	r						
yam	t						
pana	u						
cassava	v						

Note: The table of % area is only approximate due to rounding small numbers

13.9 The main disease damage in area terms is to coconuts, where **7%** of the (total) cultivated area shows effects of leaf damage and **9%** of the (total) cultivated area shows effects of damage to the nuts. There are scattered occurrences of disease damage to root crops, with **6%** of sweet potato plots showing disease damage to leaves (5 plots), but for the most part the effects of disease appears minor in terms of frequency and area.

13.10 Fire, flood and wind damage are together described in table 13.5 where, of course, the "part of crop affected" no longer applies.

Table: 13.5
FIRE, FLOOD AND WIND CROP DAMAGE

i) Damage by frequency of damage encountered (plots)

nature of damage:		fire	flood		wind				frequency
extent of damage:		little	little	consi-derable	little	consi-derable	severe	devast-ion	of plots
all crops (total)			1	5	4	3	1	1	151
cleared land	a								1
coconut	b				4	2		1	26
cocoa	c					1			2
grain crops	e								2
beans	f								1
cabbage	g								1
fruit crops	j								3
banana	l								1
tobacco	q								1
sweet potato	r			5					79
yam	t		1				1		24
pana	u								8
cassava	v								2

ii) Damage by % cultivated area affected

nature of damage:		fire	flood		wind			
extent of damage:		little	little	consi-derable	little	consi-derable	severe	devast-ion
all crops (total)					11	7		
cleared land	a							
coconut	b				11	7		
cocoa	c							
grain crops	e							
beans	f							
cabbage	g							
fruit crops	j							
banana	l							
tobacco	q							
sweet potato	r							
yam	t							
pana	u							
cassava	v							

Note: The table of % area is only approximate due to rounding small numbers

3.11 There is no fire damage, but some (considerable) flood damage on 6% of sweet potato plots. Wind damage was observed on 27% of coconut plots (7 plots). On only 2 plots was damage "considerable" but one plot was devastated.

13.12 Rat and bird damage are similarly described in table 13.6.

Table: 13.6
RATS AND BIRDS CROP DAMAGE
i) Damage by frequency of damage encountered (plots)

nature of damage:		rats			birds			frequency
extent of damage:		little	consi-derable	severe	little	consi-derable	severe	of plots
all crops (total)		16	17	10	10	3	5	151
cleared land	a							1
coconut	b				2			26
cocoa	c							2
grain crops	e							2
beans	f							1
cabbage	g							1
fruit crops	j		2					3
banana	l							1
tobacco	q							1
sweet potato	r	15	14	10	7	2	5	79
yam	t					1		24
pana	u							8
cassava	v	1	1		1			2

ii) Damage by % cultivated area affected

nature of damage:		rats			birds		
extent of damage:		little	consi-derable	severe	little	consi-derable	severe
all crops (total)		2	2	2	2		2
cleared land	a						
coconut	b						
cocoa	c						
grain crops	e						
beans	f						
cabbage	g						
fruit crops	j						
banana	l						
tobacco	q						
sweet potato	r	2	2	2	2		2
yam	t						
pana	u						
cassava	v						

Note: The table of % area affected is only approximate due to rounding small numbers

13.13 Rat and, to a lesser extent, bird damage is almost entirely seen on root crops. Rats damaged **49%** of sweet potato plots (39 plots), the majority showing considerable or severe damage. **18%** of sweet potato plots (14 plots) were damaged by birds, where tubers are uprooted up and eaten.

13.14 Damage due to bats and livestock, and other types of damage, is described in table 13.7.

Table: 13.7
BATS, LIVESTOCK AND OTHER CROP DAMAGE
i) Damage by frequency of damage encountered (plots)

nature of damage:		bats		livestock		other damage		frequency
extent of damage:		little	consi-derable	consi-derable	severe	little	consi-derable	of plots
all crops (total)		1	5	3	2	1	7	151
cleared land	a							1
coconut	b	1				1		26
cocoa	c							2
grain crops	e							2
beans	f							1
cabbage	g							1
fruit crops	j							3
banana	l							1
tobacco	q							1
sweet potato	r		5	3	2		7	79
yam	t							24
pana	u							8
cassava	v							2

Note: Bats damage to sweet potato refers to banana growing in the mixture
"Other" damage is crabs and frogs

ii) Damage by % cultivated area affected

nature of damage:		bats		livestock		other damage	
extent of damage:		little	consi-derable	consi-derable	severe	little	consi-derable
all crops (total)			1				1
cleared land	a						
coconut	b						
cocoa	c						
grain crops	e						
beans	f						
cabbage	g						
fruit crops	j						
banana	l						
tobacco	q						
sweet potato	r		1				1
yam	t						
pana	u						
cassava	v						

Note: The table of % area is only approximate due to rounding small numbers

13.15 Damage again is mostly to sweet potato where 6% of plots (5 plots) experienced considerable bat damage (but to banana growing in mixture); 6% of plots experienced considerable or severe livestock damage; and 9% of plots (7 plots) were damaged by crabs and frogs.

13.16 Table 13.8 describes crop management and the application of chemical inputs.

Table: 13.8

MANAGEMENT AND APPLICATION OF AGRICULTURAL INPUTS

i) Inputs by frequency of use (plots)

crop type		row planting	fert-iliser	pest-icide	manure	ash	other	frequency of plots
all crops (total)		29	1				1	151
cleared land	a							1
coconut	b	21						26
cocoa	c	2						2
grain crops	e	2						2
beans	f						1	1
cabbage	g	1	1					1
fruit crops	j	1						3
banana	l							1
tobacco	q							1
sweet potato	r							79
yam	t	1						24
pana	u							8
cassava	v	1						2

Note: "Other" is the planting of marigold to protect beans from insect damage

ii) Inputs by % cultivated area applied

crop type		row planting	fert-iliser	pest-icide	manure	ash	other
all crops (total)		67					
cleared land	a						
coconut	b	62					
cocoa	c	4					
grain crops	e						
beans	f						
cabbage	g						
fruit crops	j						
banana	l						
tobacco	q						
sweet potato	r						
yam	t						
pana	u						
cassava	v						

Note: The table of % area is only approximate due to rounding small numbers

13.17 Row planting is practiced mainly on coconuts, cocoa and fruit and vegetable crops. There is only one case of fertiliser application, on a cabbage plot, - and no pesticide, manure or ash was applied. Only one case of crop protection was recorded, in which marigolds were planted in a bean crop to control insect damage.

Chapter: 14
CROP YIELDS

14.1 Production data on smallholder agriculture are scarce, largely due to practical difficulties associated with measuring yields in complex cropping systems that lack clear temporal and spatial boundaries. Smallholder agriculture is a continuous process in which there is little seasonality, so that any or all stages of crop growth and management operations may be exhibited at any time, with crops commonly harvested selectively over time. Table 14.1 summarises the planting characteristics of smallholder crops in Marau Sound.

Table: 14.1
CROP VARIETY AND SPACING

crop type		number of observations	% improved crop type	spacing (% obs) customary	regular	recommended tree crops triangular	recommended tree crops square
Cleared	Cleared land	1					
Coconut/Cocoa	Coconuts	28		25	25	29	21
	Cocoa	4	75		75	25	
Ground crops	Grain crops	12	50	58	33	8	
	Beans	5	40	80		20	
	Cabbage	9	22	89		11	
	Vegetable	2	100	50		50	
	Chilli						
	Fruit Crops	24		96		4	
Tree/other crops	Fruit trees						
	Banana	46		98		2	
	Citrus trees						
	Nut trees	1		100			
	Sugar cane	15		100			
	Food/building tree	1		100			
	Tobacco	1		100			
Root crops	Sweet potato	87	1	98	1	1	
	Taro Common	31		100			
	Giant						
	Hong Kong	4		100			
	Swamp						
	Yam	35	3	97	3		
	Pana	37		97	3		
	Cassava	42		95	5		
	Other root crop						
Total		385					

14.2 The second column refers to the introduction of non-traditional planting material through extension or research, or from other sources. A high proportion of vegetable crops are introduced, but fruit and nut trees and root crops are essentially local types.

14.3 For non-tree crops there are three types of spacing identified, being "customary", "regular" and "recommended". "Customary" means that crops are planted according to local norms and commonly exhibit little discernable order in the plot. "Regular" means planting according to a visible pattern, such as in rows. "Recommended" refers to the adoption of other recommended practices. For tree crops there are four categories of "customary", "regular", "triangular" and "square". "Customary" and "regular" follow the same rules as non-tree crops. "Triangular" and "square" equate with recommended practices for coconuts.

14.4 In the survey area **25%** of coconuts were planted according to "custom" without discernable order. **50%** were planted either square or triangular, with the remaining **25%** showing some order but not according to established recommendations. Other crops are mostly planted according to custom, although a high proportion of vegetable planting is ordered.

14.5 Crop mixtures in smallholder farming systems are complex, as seen in table 9.3. Table 14.2 describes something of the the complexity of planting densities. **86%** of coconut and **50%** of cocoa stands are monocropped, but complexity is exhibited in annual and other tree crops where there is little planting in pure stands. **28%** of sweet potato plots are upwards of 90% dominant or pure stand, with sweet potato comprising **50%-80%** dominance in the majority of plots. A similar pattern, but at lower densities, is seen in yam and pana. Cassava, a minor crop, is generally planted as a small proportion of mixtures.

Table: 14.2
CROP DOMINANCE IN MIXTURES

(--------- crop type ----------)		number of observations	(---------- % dominance in mixture ----------)										
			0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	80 - 90	90 - 100
Cleared	Cleared land	1										
Coconut/Cocoa	Coconuts	28	7		7							86
	Cocoa	4							50			50
Ground crops	Grain crops	12	67	8	8						8	8
	Beans	5	60	40								
	Cabbage	9	56	11	22	11						
	Vegetable	2	50	50								
	Chillie											
	Fruit Crops	24	54	17	4		4	8				13
Tree/other crops	Fruit trees											
	Banana	46	65	20	9	4	2					
	Citrus trees											
	Nut trees	1	100									
	Sugar cane	15	93	7								
	Food/building tree	1	100									
	Tobacco	1										100
Root crops	Sweet potato	87	3	3	2	9	8	13	14	13	7	28
	Taro Common	31	71	26	3							
	Giant											
	Hong Kong	4	100									
	Swamp											
	Yam	35	11	9	6	17	23	14	3	3	3	11
	Pana	37	16	11	19	19	22	8	3		3	
	Cassava	42	55	29	7	5	2					
	Other root crop											
Total		385										

14.6 A visual assessment of yields is presented in table 14.3.

Table: 14.3
CROP PRODUCTION

crop type		number of observations		yield appearance (% obs)		
		total	zero yield (or not mature)	low	moderate	high
Cleared	Cleared land	1				
Coconut/Cocoa	Coconuts	28	3	44	40	16
	Cocoa	4	1	67	33	
Ground crops	Grain crops	12	6		83	17
	Beans	5	1		75	25
	Cabbage	9		22	67	11
	Vegetable	2			100	
	Chilli					
	Fruit Crops	24	6		44	56
Tree/other crops	Fruit trees					
	Banana	46	11	26	66	9
	Citrus trees					
	Nut trees	1				100
	Sugar cane	15	3	17	58	25
	Food/building tree	1	1			
	Tobacco	1			100	
Root crops	Sweet potato	87	12	17	61	21
	Taro Common	31	7	4	79	17
	Giant					
	Hong Kong	4	1	33	33	33
	Swamp					
	Yam	35	12		65	35
	Pana	37	11	4	54	42
	Cassava	42	6	8	69	22
	Other root crop					
Total		385	81	=	21 % zero or not mature	

Note: Yield appearance is the % of crop observations which are not devastated and close to harvest

14.7 Most yield observations are "moderate" with a spread of "low" and "high" yields recorded. Coconuts are mostly low to moderate yielding, with **44%** low and **40%** high. Vegetable crops are moderate to high yielding, but root crops again are mainly moderate yielding with a spread of low and high observations. Yam and pana, which tend to be planted onto newly opened fertile sites, are mainly moderate to high yielding, as is cassava which is tolerant of low soil fertility. Taro and sweet potato are mainly moderate to high yielding, but with a substantial proportion of the crop classed a s low yielding.

14.8 In an intensive case study of this kind it is difficult to obtain a reasonable coverage of crop yields, although these are recorded where possible in the course of the survey[12]. A crop production study has been designed to generate yield data[22] but it has not been possible to implement this yet. For the present report yields are derived from secondary sources.

a) COCONUT:

14.9 Coconut production data from the 1974-75 agricultural survey are summarised in table 14.4.

Table: 14.4
COCONUT PRODUCTION DATA FROM 1974-75 AGRICULTURAL SURVEY

	Province				Mean
	Western	Ysabel Central Guadalcanal	Malaita	Makira Temotu	Solomon Islands
number of yield sites	28	32	3	30	93
coconuts per palm: disciplined	53	54	19	34	44
customary	22	36	1	41	31
mean	31	42	14	37	36
coconuts per ha : disciplined	8,194	8,983	2,822	5,773	7,178
customary	4,658	8,595	135	7,432	6,703
mean	5,794	8,753	1,926	6,492	6,913
% damaged/unusable nuts: disciplined	12	10	12	20	14
customary	19	13	36	6	13
mean	16	12	12	13	14
gross copra yield (kg/ha): disciplined	1,541	1,689	531	1,086	1,450
customary	876	1,616	25	1,398	1,261
mean	1,081	1,646	362	1,221	1,300
net yield (kg/ha): disciplined	1,356	1,520	467	869	1,247
customary	709	1,406	16	1,314	1,097
mean	908	1,448	318	1,062	1,118

Source: Statistics Office (1978) "1974-75 Agricultural Statistics Survey".
Note: Copra yields assumse 190gm dried copra per nut quoted in the Statistics Office report

14.10 In the 1974-75 agricultural survey the mean coconut yield is estimated to be **1,300kg/ha** copra equivalent, or **1,118kg/ha** when unusable nuts are discounted. The average daily consumption of coconuts was found to be **4.2** per household, resulting in a national annual consumption equivalent of **8,871MT** copra. If green nuts are taken into account it was believed[5] that the copra equivalent consumed would be **10,000MT** in a year when exports amounted to **28,000MT**.

14.11 Charles (1980) estimates lower levels of copra production, with estates yielding **827kg/ha** and smallholders the much lower level of **410kg/ha**. The difference he attributed to a high proportion of immature plantings and the consumption of coconuts in the smallholder sector[23]. Average copra production derived from the 1985 coconut survey is estimated in the (draft) Farm Management Handbook for Solomon Islands to be **0.72MT/ha**[24], although provincial yields vary from **1.15MT/ha** in Central Province, which is dominated by the Levers plantation in the Russel Islands, to **0.38MT/ha** in Temotu.

14.12 In conjunction with the 1985 coconut survey the Research Department of the Ministry of Agriculture and Lands has analysed the nutritient status of coconut soils soils in Solomon Islands[13]:

Coconut Soils Data:
(means of soils analyses conducted on Coconut Survey soils)

pH	N%	avaialble P ppm	exchangeable K meq/100g	avaialble K meq/100g
6.4	0.55	70	0.24	0.60

14.13 It was concluded that coconut soils are generally high in nitrogen, medium in phosphate, and low in potassium. Recent variety experimental results on fertilised coconuts show the following yields:

Coconut Research Results (dry copra eq kg/ha):

Site	Tenaru (Guadalcanal)		Gizo (Western)	
Year	1985	1984	1985	1984
Dwarf:Rennel Hybrid	378	2,664	1,990	1,599
Dwarf:Local Tall Hybrid	383	1,391		
Local Tall			1,830	334
Rennel	190	1,391	1,910	1,052
Mean				995

14.14 Smallholder yields in the present report are estimated to be **800kg/ha** dry copra equivalent usable nuts, of which **350kg** equivalent might be consumed.

b) COCOA:

14.15 Research trials on cocoa[13] from 1977 to 1985 at Black Post in Guadalcanal produced a mean dry beans yield of **1,898kg/ha** for Amelonado, **2,780kg/ha** for AmlxNa33 hybrid, and **2,444kg/ha** for AmlxPa7 hybrid.

14.16 Cocoa yields from various sources are quoted in the (draft) Farm Management Handbook for Solomon Islands[24]:

Smallholder Cocoa Yields (kg/ha)[24]:

Age of tree (year)	3	4	5	6	7	8
Friend (1970)	21	126	215	220	220	173
DBSI (1983) *	150	250	600	1,200	1,450	1,450
Hiele (1988)	208	450	560	685	719	719

* unverified source

14.17 High variability in yields was attributed to differences in management, such as in the application of fertiliser, weeding, and pest and disease control.

14.18 Smallholder cocoa yields which are mainly unfertilised, are estimated in the present report to be **600kg/ha** dry beans.

c) SWEET POTATO:

14.19 In a study of north-west Malaita, Frazer[15] investigated the effect of fallow period on smallholder sweet potato yields. After a long fallow of 15-20 years the mean yield was found to be **14.84MT/ha** from 8 observations. After a "short" fallow of less than 10 years the mean yield was **8.99MT/ha** from 5 observations. Gollifer[16] looked at the effects of potassium and nitrogen application on annual crops on soils of the Dala Series in Malaita, soils formed on a parent material of raised coral reef and characteristically low in potassium. He found unfertilised sweet potato yields of **5.5MT/ha** (control for K) and **7.4MT/ha** (control for N). The effect of potassium application was to increase yields by up to 86%, but nitrogen tended to stimulate vine growth at the expense of the tuber.

14.20 In a series of trials at Dala, Gollifer[17] found unfertilised sweet potato yields to range widely, from around **0.25MT/ha** to **24MT/ha**. Yields in general were the order of **5MT/ha**, which was estimated to be around half the typical North West Guadalcanal yield of **9.97MT/ha**. Yield variability could not be attributed to variety or soil type, but a trend related to intensity of cropping did appear:

Effect of Recent Land History on Sweet Potato Yields (MT/ha):

land history	yield (MT/ha)
continuous cropping	3.51
0 - 4 years fallow	4.77
5 - 9 years fallow	6.03
more than 10 years fallow	9.29

Source: Gollifer (1969)

4.21 It was concluded that sweet potato and other root crops are demanding of, and remove large quantities of, potassium from the soil. A fallow-burn cycle is therefore essential to replenish soil fertility by making potassium available to shallow-rooted crops. It was considered that deep rooting trees may act as nutrient pumps, but the only practical way of shortening fallow periods was considered to be the application of potassium fertiliser[17].

4.22 Bathgate[18] found also that yields vary according to soil fertility and growing time, as well as species and density of planting. In West Guadalcanal he quotes sweet potato yields of **7.16MT/ha** after 20 years of fallow and **9.36MT/ha** after 8 years of fallow, but based on a single sub-plot observation only in each case.

4.23 On the weather coast of Guadalcanal Chapman and Pirie[19] studied the relationship between yields and cropping, and found yields to be high in comparison to studies elsewhere:

Sweet Potato Yield (MT/ha) - Weather Coast, Guadalcanal

successive crops	Ghauvalisi	Sughu	Hatare/Poinaho
1	41.67	18.08	17.82
2	15.31	10.54	9.79
3		10.29	9.79

Source: Chapman and Pirie (1974)

14.24 In the 1974-75 Agricultural Survey[5] the mean yield of sweet potato was **15.7MT/ha**, but this was felt to be an over-estimate.

14.25 More recent research provide further information on sweet potato yields, but results exhibit considerable variability across seasons and due to other causes:

trial	yield MT/ha		notes
	gross	marketable	
improved cultivars	17.9	14.5	25 obs
control	11.2	6.7	1 obs
dry season corn intercropping	15.9	7.1	135 days to harvest
	18.5	12.0	165 days to harvest
wet season corn intercropping	5.9	1.5	135 days to harvest
	11.0	3.4	165 days to harvest
dry season weevil control	15.3		no effect from insecticide
wet season weevil control	8.19	6.37	

Source: Research Department Annual Report 1984[14] and 1985[13]

14.26 Smallholder sweet potato yields of usable crop are estimated in the present report to be **8MT/ha** under long fallow of 8 years or more - falling to **5MT/ha** for fallow of 4 to 8 years, and **3.5MT/ha** for short fallow cropping.

d) <u>TARO</u>:

14.27 Taro yields in the literature are highly variable. Frazer[15] found <u>Colocasia esculenta</u> to yield **8.94MT/ha** in North Malaita, based on 10 observations. Gollifer[16] on the Dala Series in Malaita found yields of **4.0MT/ha** for unfertilised taro, which increased to **6.0MT/ha** with 168kg/ka potassium fertiliser applied. Gollifer[17] also quotes widely ranging unfertilised taro yields of **1.00 to 10.80MT/ha** on experimental plots. In a spacing trial in Guadalcanal at Tenaru on which fertiliser was applied, the net undamaged taro yield for densities of 2,000 to 4,000 plants/ha was around **5MT/ha**, with 30% loss due to corm damage[14]. On the same site a high intensity inputs and management trial to investigate leaf blight yielded around **9MT/ha** marketable corms[14]. The control yield in a 1985 taro beetle trial at Tenaru was **3.49MT/ha**[13]. Tioti (1967) estimated taro yields to be **12.6MT/ha**[25], but Gollifer (1970) quotes yields of **4.7MT/ha**[26].

14.28 The smallholder taro yield in the present report is estimated to be **5MT/ha.**

e) **YAM:**

14.29 In North Malaita Frazer[15] found yam yields of **5.16MT/ha** for Dioscorea alata. Gollifer[17] quotes unfertilised yam yields of **6.03MT/ha** to **30.38MT/ha** at Dala experimental station on Malaita. In 1984 an experiment to compare the yields of 18 yam cultivars was conducted at Tenaru in Guadalcanal[14] in which the cultivars with high resistance to dieback yielded around **14** to **18MT/ha**, with the highest resistance cultivar yielding **24MT/ha.** Susceptible cultivars produced yields as low as **2MT/ha.** Maeinia[27] quotes very high yields of **50 - 63MT/ha** for Malaita.

14.30 Smallholder yam yields are likely to be higher than those of sweet potato given that they tend to be planted on newly opened sites and the yield appearance is generally good. In the present report long term fallow is expected to yield **10MT/ha**, fallow of 4-8 years to yield **6MT/ha** and short fallow systems to yield **4MT/ha.**

f) **PANA:**

14.31 Frazer[15] quotes a for North Malaita, where on one observation only of Dioscorea esculenta produced a yield of **11.52MT/ha.** Fertilised cultivar trials at Dodo Creek Research Station[14] in 1984 yielded **16.2MT/ha** marketable tubers out of a total yield of **27.7MT/ha.** 1983 results were higher, with **43.7MT/ha** marketable tubers out of a total yield of **52.9MT/ha.** The difference was believed to be due to inadequate fertiliser in 1984. In 1985 the mean fertilised yield of 8 cultivars was **24.3MT/ha** marketable tubers[13].

14.32 Smallholder pana yields in the present report are expected to be similar to yam yields - of **10MT/ha** under long fallow, **6MT/ha** under 4-8 years fallow, and **4MT/ha** under short fallow.

g) CASSAVA:

14.33 Fertilised cassava in a time of harvest trial at Dodo Creek in Guadalcanal[13] yielded **23.8MT/ha** after 9 months and **27.8MT/ha** after 12 months. In a fertilised germplasm collection trial on the Fataolo land system on Malaita 17 cultivars ranged from 7.5 to **65.8MT/ha**, with 50% above 40MT/ha[28].

14.34 Smallholder cassava is generally planted on less fertile sites and is commonly a minor crop in a mixture. It is high yielding, although of low nutritional value. Smallholder yields in the present report are estimated to be **10MT/ha**.

h) MAIZE:

14.35 Gollifer[16] quotes unfertilised maize yields of **1.90MT/ha** on Dala soils in Malaita, but yields of **5.58MT/ha** when fertilised with NPK. Further unfertilised maize yield data from Dala[17] range from **1.55MT/ha** to **2.13MT/ha**.

14.36 Smallholder maize yields in the present report are estimated to be **1.8MT/ha**.

i) GROUNDNUT:

14.37 Gollifer quotes unfertilised groundnut yields in the range **527kg/ha** to **1,278kg/ha** from Dala in Malaita.

14.38 Samllholder groundnut yields in the present report are estimated to be **600kg/ha**.

j) SUMMARY OF YIELDS:

14.39 Crop yields derived from secondary sources are necessarily imprecise in the present context because of the complexity of smallholder farming systems. Diverse crop mixtures, with varying crop densities and differing site conditions do not lend themselves to a simple analysis of crop yields or smallholder production. Crop yields in the literature are generally for pure stand crops, or very simple mixtures - under controlled or even modified conditions. There is then a need to study smallholder production under more realistic conditions, as is part of the on-going programme of the Agricultural Economics Section. In the meantime, a "best estimate" of smallholder yields is presented in table 14.5

Table: 14.5
SMALLHOLDER CROP YIELDS

crop	condition	yield kg/ha
coconut	copra equivalent	800
cocoa	dry beans	600
sweet potato	> 8 years fallow	8,000
	4 - 8 years fallow	5,000
	< 4 years fallow	3,500
taro		5,000
yam	> 8 years fallow	10,000
	4 - 8 years fallow	6,000
	< 4 years fallow	4,500
pana	> 8 years fallow	10,000
	4 - 8 years fallow	6,000
	< 4 years fallow	4,500
cassava		10,000
maize		1,800
groundnuts		600

14.40 In parallel with the AES farming Systems Survey the Statistics Office of the Ministry of Finance conducted a "Project Beneficiary Monitoring and Evaluation" (PBME) study on six of the sites covered by the AES survey. This makes it possible to utilise smallholder production data from the PBME exercise. Those results are discussed in chapter 15 which follows.

Chapter: 15
SMALLHOLDER PRODUCTION

15.1 Under the Rural Services "Project Benificiary Monitoring and Evaluation" undertaken by the Statistics Office, gross crop offtake and other primary production were measured. Unpublished provisional results, courtesy of the Statistics Office, are presented in table 15.1.

Table: 15.1
DAILY SMALLHOLDER PRODUCTION

Average daily production from entire household (kg):

commodity	Province and Site						
	Ysabel	Central	Guadalcanal	Malaita	Makira	Temotu	Average
	Susubona	Hakama	Marau Sound	Afio	NW Peninsula	Lata	
sweet potato	8.00	2.67	6.68	3.79	4.09	4.19	4.90
cassava	1.26	0.98	2.15	0.35	0.63	0.04	0.90
yam	0.68	1.68	0.71	2.25	0.65	0.90	1.14
pana	0.58	4.60	0.32	0.06	0.34	0.12	1.00
taro	0.71	0.32	0.45	1.60	1.37	1.15	0.93
breadfruit	0.01		0.03	0.01		0.11	0.03
banana	0.55	0.56	1.85	0.83	2.06	0.28	1.02
sub-total	11.79	10.80	12.20	8.90	9.13	6.78	9.93
coconut	0.44	0.49	3.55	1.41	2.54	0.43	1.48
cabbage	0.24	0.26	0.40	0.75	0.71	0.32	0.45
other veg	0.29	0.12	0.24	0.05	0.37	0.08	0.19
other fruit	0.91	0.31	2.01	0.89	1.90	0.41	1.07
fresh meat			0.01		0.01	0.03	0.01
fresh fish	0.69	0.40	0.57	0.32	0.25	0.12	0.39
crab/shellfish	0.58	0.20	0.13	0.23	0.02	0.05	0.20
milk/eggs	0.01				0.00		0.00
betel nut	0.09	0.08		0.16	0.06	0.11	0.08
local tobacco		0.03			0.01	0.01	0.01
Based on observations from the following number of "household days":	1,200	960	480	840	1,200	720	900

Source: Statistics Office PBME unpublished results.

15.2 On average there are 9.93kg of staple crops produced daily, the crop composition varying according to area and season. Given a national mean household size of 6.50 from the 1986 population census this would provide each man, woman and child with approximately 1.5kg of staple per day.

15.3 The average household daily production of cabbage is 0.45kg, other vegetables **0.19kg** and fruit **1.07kg**. Only **0.01kg** of fresh meat is consumed daily in comparison with **0.39kg** (whole) fresh fish and **0.20kg** crabs and shellfish. National coconut consumption is estimated to be **1.48kg** husked unshelled nuts per day, which amounts to an average consumption of **4.26** nuts per household per day according to the mean nut weights in the survey.

15.4 Results from table 15.1 are transformed into annual production in table 15.2 using the simplifying assumption that the survey period is representative of the rest of the year. This is only a first approximation of smallholder yields.

Table: 15.2
ANNUAL SMALLHOLDER PRODUCTION

Average annual production from entire household (kg):

commodity	Province and Site						
	Ysabel	Central	Guadalcanal	Malaita	Makira	Temotu	Average
	Susubona	Hakama	Marau Sound	Afio	NW Peninsula	Lata	
sweet potato	2,919	974	2,439	1,382	1,492	1,528	1,789
cassava	460	357	786	129	231	15	330
yam	247	612	260	823	236	329	418
pana	212	1,677	116	23	123	44	366
taro	259	117	163	584	501	419	341
breadfruit	3		12	4		39	10
banana	201	204	674	304	750	101	372
sub-total	4,302	3,942	4,451	3,249	3,333	2,474	3,625
coconut (kg)	159	179	1,295	515	928	156	539
(nuts)	667	621	1,864	1,508	4,088	427	1,626
cabbage	88	94	145	274	261	117	163
other veg	107	43	87	17	136	28	70
other fruit	331	112	735	325	692	150	391
fresh meat			3		4	10	3
fresh fish	250	145	208	117	90	44	142
crab/shellfish	211	72	49	86	7	19	74
milk/eggs	2				0		0
betel nut	34	27		57	20	41	30
local tobacco		9			4	3	3

15.5 From table 9.2 the average root crop area in Marau Sound is **0.286ha** of which sweet potato is dominant on **0.192ha**, yam on **0.063ha**, pana on **0.024ha** and cassava on **0.007ha**. These crops occur in complex mixtures, so that simple cropping patterns can only be used as a first approximation for the actual crop coverage.

15.6 Table 15.3 is a summary of available production data from the farming systems survey and the PBME exercise. It is not possible to directly relate aggregate production data to average cropping patterns until a more detailed detailed analysis of smallholder production is available.

Table: 15.3
SMALLHOLDER PRODUCTION SUMMARY

commodity	area (ha)	growing period (months)	annual production (kg)
sweet potato	0.192	4.0	2,439
cassava	0.007	9.0	786
yam	0.063	7.8	260
pana	0.024	8.4	116
taro			163
breadfruit			12
banana			674
Source table:	9.2	11.3	15.2

Chapter: 16
LABOUR

16.1 With no cash inputs applied in the farming systems under study, the main component in the socio-economy of smallholder agriculture is labour. Table 16.1 presents an overview of labour constraints expressed by farmers. The first part of the table shows the frequency of gardens affected and is expressed in terms of area affected in the second part.

Table: 16.1
LABOUR CONSTRAINTS

i) Labour Constraints by number of observations (gardens)

crop type:	tree crops	short term cash crops	food crops	all crops
no limitation	3	3	74	80
lack of labour	11		2	13
lack of inputs/cash	2		3	5
lack of labour + cash	6			6
garden too far from house			2	2
garden too far + labour	1			1
garden too far + cash				
too far + labour + cash				
total by crop type	23	3	81	107

ii) Labour Constraints by % area of holding

crop type:	tree crops	short term cash crops	food crops	all crops
no limitation	7		23	30
lack of labour	37			37
lack of inputs/cash	9		2	12
lack of labour + cash	21			21
garden too far from house				
garden too far + labour				
garden too far + cash				
too far + labour + cash				
total by crop type	74		26	100

Note: The table of % area is only approximate due to rounding small numbers

16.2 Diagram 16.1 summarises labour constraints by area, and refers to the "average" holding of 1.169ha defined in table 9.2, in which 74% is tree crops and 26% is food crops.

16.3 As has been seen in an analysis of labour density in chapter 8, coconut management in chapter 10, and factors affecting production in chapter 14, the dominant constraint is found to be labour on tree crops. A labour shortage is recorded on **78%** of the tree crop area, while a shortage of inputs or cash is recorded on **41%** of the area. In contrast only **8%** of the food crop area is affected by a shortage of inputs or cash and there is no indication of a labour shortage.

16.4 Distance from the household to the garden is not a significant problem. In Chapter 12 it was shown that the mean distance from households is 0.216 hours, up to a maximum distance of **1.4** hours.

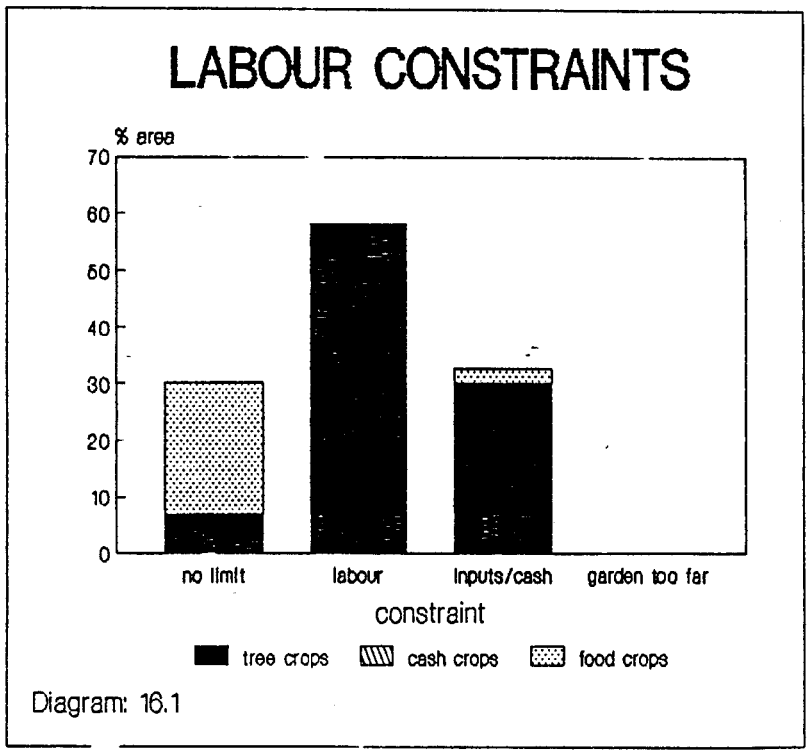


Diagram: 16.1

16.5 Table 16.2 summarises the labour requirements of the average holding, derived from individual plot labour studies presented in annex 2. The table is a "model" budget representing the average of complex and diverse holdings. Individual crop budgets in annex 2 may be used to construct farm budgets for hypothetical holdings, but caution should be exercised where there are few observations. Labour days in budgets presented here are based on actual hours worked per day, which are quite variable. Again, tables in annex 2 may be used to convert work hours into "standard" work days if required. Since table 16.2 represents the average holding, crops which comprise only minor mixtures in cropping patterns do not appear in the summary labour budget.

16.6 The table shows the labour requirement of each agricultural operation according to crop, which may be a pure stand or more commonly the dominant crop in a mixture. Agricultural operations cover: land clearance; cultivation; planting; first, second and third weeding; and harvesting. For some crops - notably, but not exclusively, trees - there may be additional operations such as pruning or thinning which do not easily fall within the standard classification. Two general categories of establishment and maintenance operations are therefore included. Such a classification provides good coverage for most activities and allows diverse crops to be handled in a standard manner.

16.7 In the interpretation of labour budgets it should be remembered from chapter 9 that while coconuts account for **70%** of the cropped area they are grown by only **41%** of farmers. Thus the majority of tree cropping farmers will require more labour on tree crops than specified, while non-tree cropping farmers will not require any. Labour budgets are also presented on the basis of labour input "when operations are performed". Adjustment is not made to the labour input to take account of operations which are omitted, forinstance where a proportion of plots are not weeded a second or third time. The number of observations on which labour operations are based in annex 2 provides a guide to the relative frequency that operations are performed, and so adjustments can be made to budgets based on different assumptions about management intensity. Incorporating this into the present analysis would considerably increase the complexity of presentation while introducing ambiguity into the results.

16.8 The dominant labour requirement for land clearance is on coconuts, requiring 88 work days per year. Sweet potato is also demanding of labour, being the dominant root crop, and requiring 42 work days per year. On a unit area basis, however, the labour requirement of sweet potato is about twice that of coconut, being 215 work days per hectare compared with 108 work days per hectare for coconuts. The composition of labour on land clearance is about equal among men and women. Of 144 work days, men contribute 52% compared to to 47% from women, and 1% of labour on land clearance is hired. There is no apparent gender discrimination by crop type, with men and women contributing roughly equal amounts of labour over the range of crops.

16.9 Coconuts dominate the labour budget on cultivation, requiring 87 work days compared with 28 days for sweet potato. Of 126 work days per year men contribute 63% and women 37%. 1% of labour on cultivation is paid. Men account for most labour on cultivation over the entire range of crops, including tree and root crops.

16.10 Coconuts again dominate labour budgets for planting where 48 work days are spent per year on coconuts compared with 16 work days on sweet potato. Of 70 work days per year required on planting throughout the holding, men contribute 54% and women contribute 46%. Men perform most of the planting work on coconuts, accounting for 79% of the labour input. Women provide 21% of the labour input on coconut planting and account for all the labour in planting food crops.

16.11 130 days per year are worked on the establishment and tending of coconuts on which women provide 78% of the labour.

16.12 50 work days are spent per year on the maintenance of coconut plantings. Women provide 22% of this compared to only 12% from men. Mostly the maintenance of coconuts is provided by hired labour, accounting for 66% of labour on tree crops maintenance. The average annual expenditure on hired labour for coconut maintenance is SI$49.

16.13 96 work days are spent on the first weeding of crops, of which 53 days are accounted for by coconuts and 35 days by sweet potato. Labour is predominantly supplied by women, who contribute 60% of the labour on first weeding compared with 30% from men and 9% from hired labour. On coconuts men provide 51% of the labour for first weeding (brushing), women account for 32%, and 9% is from hired labour at an annual cost of SI$16. Women provide essentially all the labour on the weeding of root crops.

Table: 16.2
ANNUAL LABOUR INPUT BY HOLDING

	work days per year per holding men	women	paid	total	per ha average	% contribution men	women	paid	labour cost (SI$)
i) Land Clearance									
Cleared land									
Coconut	47	41		88	108	53	47		
Cocoa	1	1		2	42	50	50		3
Grain crops		1		1	133		100		
Cabbage									
Fruit crops									
Banana									
Tobacco									
Sweet Potato	21	19	2	42	215	50	45	5	3
Yam	3	3		6	107	50	50		
Pana	2	1		3	122	67	33		
Cassava	1	1		2	160	50	50		
Total holding	75	67	2	144		52	47	1	6
ii) Cultivation									
Cleared land									
Coconut	54	32	1	87	106	62	37	1	9
Cocoa									
Grain crops		4		4	398		100		
Cabbage									
Fruit crops									1
Banana									
Tobacco									
Sweet Potato	19	9		28	142	68	32		
Yam	4	1		5	73	80	20		
Pana	2			2	102	100			
Cassava									
Total holding	79	46	1	126		63	37	1	10
iii) Planting									
Cleared land									
Coconut	38	10		48	59	79	21		1
Cocoa									
Grain crops		2		2	179		100		
Cabbage									
Fruit crops									
Banana									
Tobacco									
Sweet Potato		16		16	83		100		
Yam		3		3	61		100		
Pana		1		1	61		100		
Cassava									
Total holding	38	32		70		54	46		1

ANNUAL LABOUR INPUT BY HOLDING (continued)

	⟨------ work days per year -----⟩ ⟨----- per holding -----⟩ men	women	paid	total	per ha average	⟨- % contribution -⟩ men	women	paid	labour cost (SI$)
iv) Establishment									
Cleared land									
Coconut	28	102		130	159	22	78		
Cocoa									
Grain crops									
Cabbage									
Fruit crops									
Banana									
Tobacco									
Sweet Potato									
Yam									
Pana									
Cassava									
Total holding	28	102		130		22	78		
v) Maintenance									
Cleared land									
Coconut	6	11	33	50	61	12	22	66	49
Cocoa									
Grain crops									
Cabbage									
Fruit crops									
Banana									
Tobacco									
Sweet Potato									
Yam									
Pana									
Cassava									
Total holding	6	11	33	50		12	22	66	49
vi) First Weeding									
Cleared land									
Coconut	27	17	9	53	65	51	32	17	16
Cocoa	1	1		2	30	50	50		
Grain crops		1		1	57		100		
Cabbage									
Fruit crops									
Banana									
Tobacco									
Sweet Potato	1	34		35	180	3	97		
Yam		5		5	80		100		
Pana									
Cassava									
Total holding	29	58	9	96		30	60	9	16

ANNUAL LABOUR INPUT BY HOLDING (continued)

	work days per year: per holding: men	women	paid	total	per ha average	% contribution: men	women	paid	labour cost (SI$)
vii) Second Weeding									
Cleared land									
Coconut	24	15	2	41	49	59	37	5	4
Cocoa									
Grain crops									
Cabbage									
Fruit crops									
Banana									
Tobacco									
Sweet Potato		23		23	120		100		
Yam		4		4	71		100		
Pana									
Cassava									
Total holding	24	42	2	68		35	62	3	4
viii) Third Weeding									
Cleared land									
Coconut	30	4	16	50	61	60	8	32	21
Cocoa									
Grain crops									
Cabbage									
Fruit crops									
Banana									
Tobacco									
Sweet Potato		9		9	49		100		
Yam		3		3	42		100		
Pana									
Cassava									
Total holding	30	16	16	62		48	26	26	21
ix) Harvesting									
Cleared land									
Coconut	65	68	2	135	164	48	50	1	5
Cocoa									
Grain crops		1		1	113		100		
Cabbage									
Fruit crops									
Banana									
Tobacco									
Sweet Potato	1	104		105	547	1	99		
Yam	5	14		19	301	26	74		
Pana									
Cassava									
Total holding	71	187	2	260		27	72	1	5

16.14 68 work days are spent on the second weeding of crops, of which 41 days are on coconuts and 23 days are on sweet potato. Women provide 62% of the labour on second weeding and perform all the weeding of root crops. Men contribute 59% of the labour on the second weeding (brushing) of coconuts, women 37% and paid labour contributes 5% at an annual cost of SI$4.

16.15 62 work days are spent on third weeding, of which men contribute 48%, women 26% and paid labour 26%. Women provide all the labour for the weeding of root crops but only 8% of the labour on coconuts. Men provide 60% of labour on the third weeding of coconuts and paid labour provides 26% at an annual cost of SI$21.

16.16 260 work days are spent on harvesting, mostly by women. Men account for 27% of labour in harvesting compared with 72% from women. 1% of harvesting labour is hired at an annual cost of SI$5. Women largely provide the labour on harvesting root crops and provide 50% of the labour on coconuts.

16.17 Overall women provide most labour, as anticipated from the labour composition of households presented in table 3.3. Men are predominantly concerned with land clearance and cultivation, and the planting of coconuts. Women share a high proportion of the labour for clearance and cultivation and provide all the labour for root crop planting. On maintenance and weeding women provide most labour, and are largely responsible for the weeding of root crops. Women provide most labour on harvesting, particularly on root crops.

16.18 Labour is a constraint on coconuts where 78% of the tree crop area has a labour shortage. This is seen in the standard of mamagement in chapter 10 in which 25% of coconut plots have reverted to secondary bush. Hired labour is necessary to make up the labour shortfall on coconuts. In contrast, labour is not a limitation on annual crops.

16.19 A labour summary presented first by crop and then by operation is provided in table 16.3. Overall there are 1,006 work days per year required on an "average" holding of which 380 are provided by men, 561 by women and 65 by paid labour at an annual cost of SI$112. The average adult man in the household spends 208 days working on the holding and the average adult woman spends 243 days, with an additional 65 days of hired labour. Communal labour, which is assumed to be reciprocated and so balances out, is included in family labour.

16.20 Men apparently contribute less farm labour than women. This is not only attributable to their lower level of labour availability among sampled households, but men also apparently work less per unit labour.

Table: 16.3
SUMMARY OF LABOUR INPUT

	⟨------ work days per year -----⟩ ⟨----- per holding -----⟩				per ha	⟨- % contribution -⟩			labour cost
i) By Crop	men	women	paid	total	average	men	women	paid	(SI$)
Cleared Land									
Coconut	319	300	63	682	832	47	44	9	105
Cocoa	2	2		4	72	50	50		3
Grain Crops		9		9	880		100		
Cabbage									
Fruit Crops									1
Banana									
Tobacco									
Sweet Potato	42	214	2	258	1336	16	83	1	3
Yam	12	33		45	735	27	73		
Pana	4	2		6	285	67	33		
Cassava	1	1		2	160	50	50		
All Crops	380	561	65	1006		38	56	6	112
ii) By Operation									
Land Clearance	75	67	2	144		52	47	1	6
Cultivation	79	46	1	126		63	37	1	10
Planting	38	32		70		54	46		1
Establishment	28	102		130		22	78		
Maintenance	6	11	33	50		12	22	66	49
First Weeding	29	58	9	96		30	60	9	16
Second Weeding	24	42	2	68		35	62	3	4
Third Weeding	30	16	16	62		48	26	26	21
Harvesting	71	187	2	260		27	72	1	5
All Operations	380	561	65	1006		38	56	6	112
Available labour units	:1.83	2.31							
Days per unit labour	: 208	243	65						

16.21 Labour by crop is illustrated in diagram 16.2. Coconuts dominate the holding labour budget with a requirement of 682 work days per year. Root crops require a further 311 work days per year. Women provide **44%** of the total labour on coconuts and almost all the labour on root crops. Overall women provide **56%** of labour, men provide **38%**, and paid labour provides **6%**.

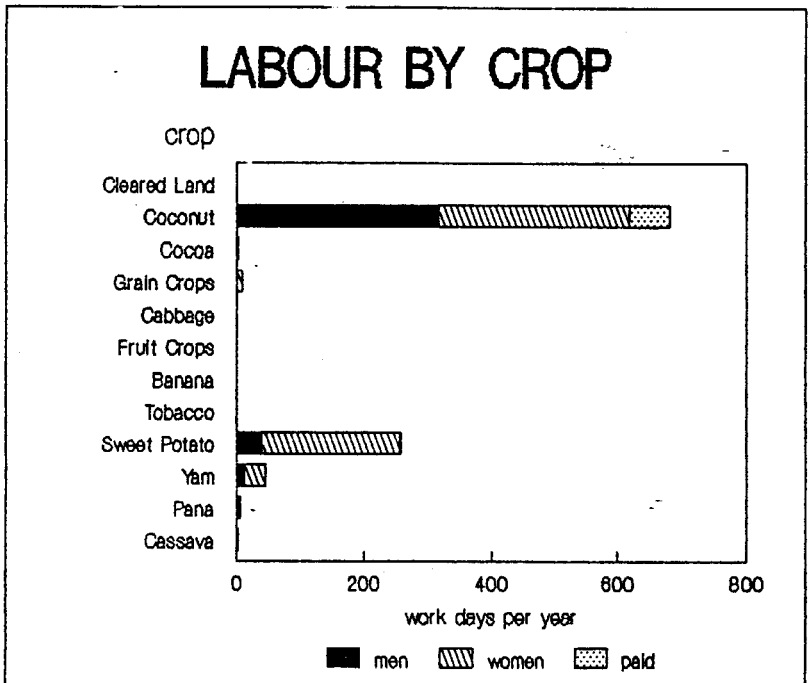


Diagram: 16.2

16.22 Labour by operation is illustrated in diagram 16.3. Women provide a high proportion of labour in all operations, particularly on harvesting.

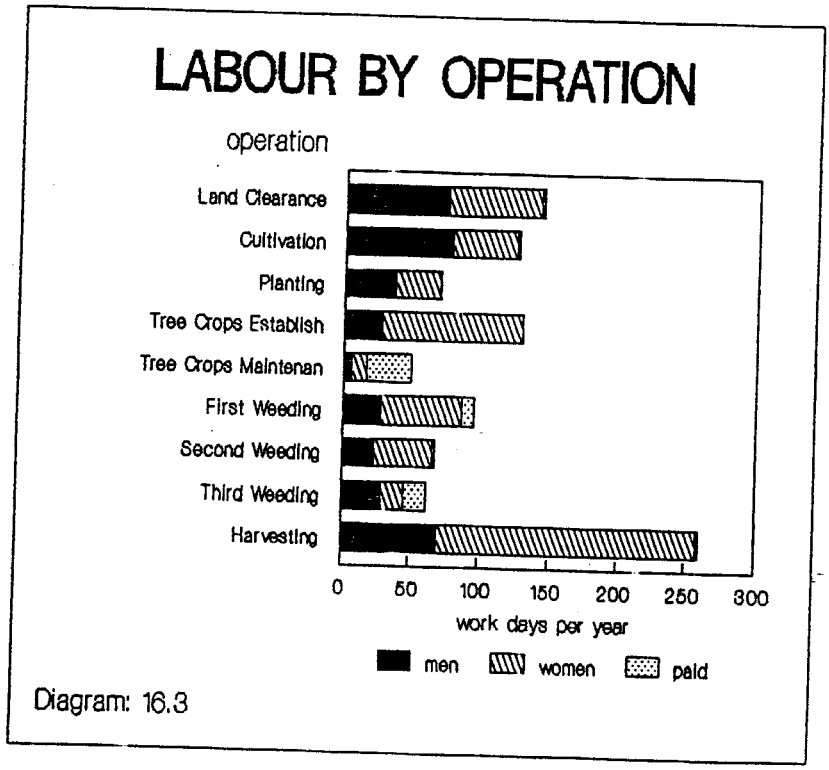


Diagram: 16.3

16.23 Flemming[29] states that Solomon Islands manpower planning figures "have erroneously assumed a far higher participation rate of men than women in the rural labour force ... It is important that attempts to clarify the rural labour force do not further these misunderstandings". The analysis of farm labour in Marau Sound supports this argument.

16.24 Diagram 16.4 illustrates the contribution from men, women and hired workers in the annual labour budget. Women provide nearly 50% more agricultural labour than men, contributing more labour overall and per household member. The average woman works 243 days on agricultural work compared with 208 days for the average man, or 17% more in terms of days per year. Differences may emerge if labour budgets are re-computed on the basis of work hours, since the average number of hours worked per day varies by operation and by crop. It is possible to re-construct budgets based on work hours rather than work days, or to standardise work days, from the tables in annex 2.

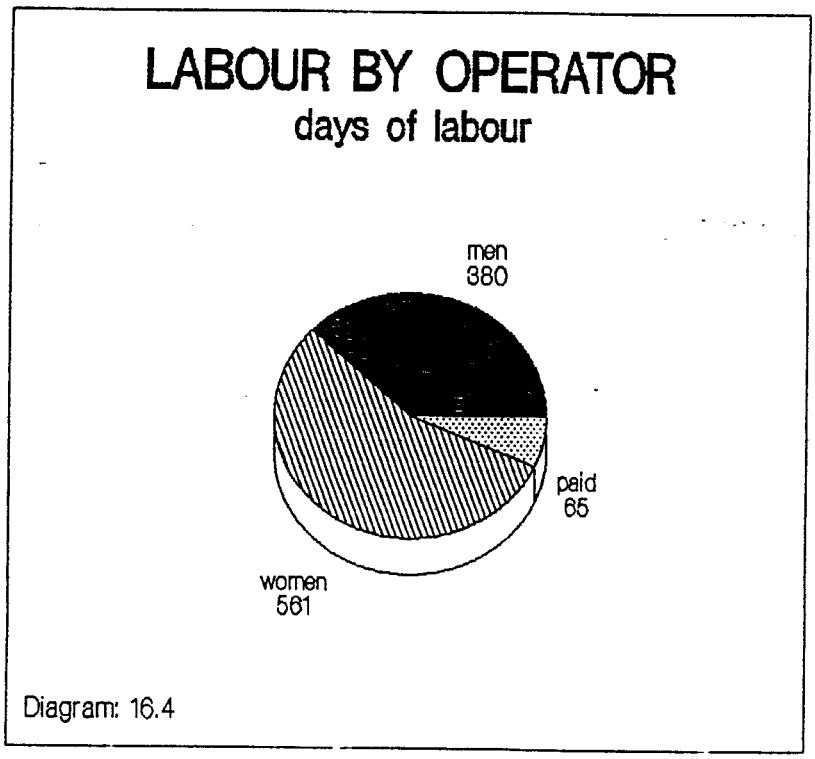


Diagram: 16.4

Chapter: 17
CROP AND FARM BUDGETS

17.1 It is not possible to produce comprehensive crop and farm budgets because of the complexity and diversity of cropping patterns, and production data are as yet incomplete. The main elements are, however, available. A summary of information on cropping patterns, production and labour is presented in Table 17.1 where source references to tables in the text shown at the foot of the table. It is not possible at this stage to directly relate production to other factors.

Table: 17.1
ELEMENTS OF A FARM BUDGET

main crop in mixture	area (ha)	annual production (kg)	annual labour	
			work days	cost (SI$)
a Cleared Land	0.002			
b Coconut (husked whole nuts)	0.818	1,864	682	105
c Cocoa	0.041		4	3
d Pasture				
e Grain Crops	0.011		9	
f Beans	0.001			
g Cabbage	0.001	145		
h Vegetables		87		
i Spices				
j Fruit Crops	0.007	735		
k Fruit trees				
l Banana	0.002	674		
m Citrus trees				
n Nut trees				
o Sugar cane				
p Food/building tree		12		
q Tobacco	0.000			
r Sweet Potato	0.192	2,439	258	3
s Taro		163		
t Yam	0.063	260	45	
u Pana	0.024	116	6	
v Cassava	0.007	786	2	
w Other root crop				
Total	1.169		1,006	111
Table reference	9.2	15.2	16.3	16.3

Chapter: 18
CASH CROP PROCESSING

18.1 Table 18.1 presents a labour budget for the production of copra. This is based on only 4 observations, or the 10% of sampled farmers earning income from copra (from table 4.2). It is considerably lower than the proportion of farmers growing coconuts, which is 41% of farming households. Copra is only produced by 25% of coconut growing farmers although from table 10.2 it is known that only 17% of stands are less than 8 years old and 3% older than 40 years. 80% of plantings should therefore be in bearing condition, however, it is also known that 25% of coconut plots are poorly maintained and that labour is a constraint.

18.2 The labour input in the production of copra is 81% family and 19% hired, at an annual cash cost of SI$27.5. Hired labour is employed for collecting and shelling nuts, and for firewood collection. Drying is performed entirely by family labour.

18.3 Copra manufacture is labour intensive, requiring 240 work days per annum to produce 1,306kg copra, or one work day per 5kg copra produced. 111 work days are spent on harvesting and shelling the nuts which account for 47% of the total production time. Firewood collection takes 60 days or 25% of the time; and drying, bagging and transport take 68 days or 28% of the time. The annual labour input is illustrated in diagram 18.1.

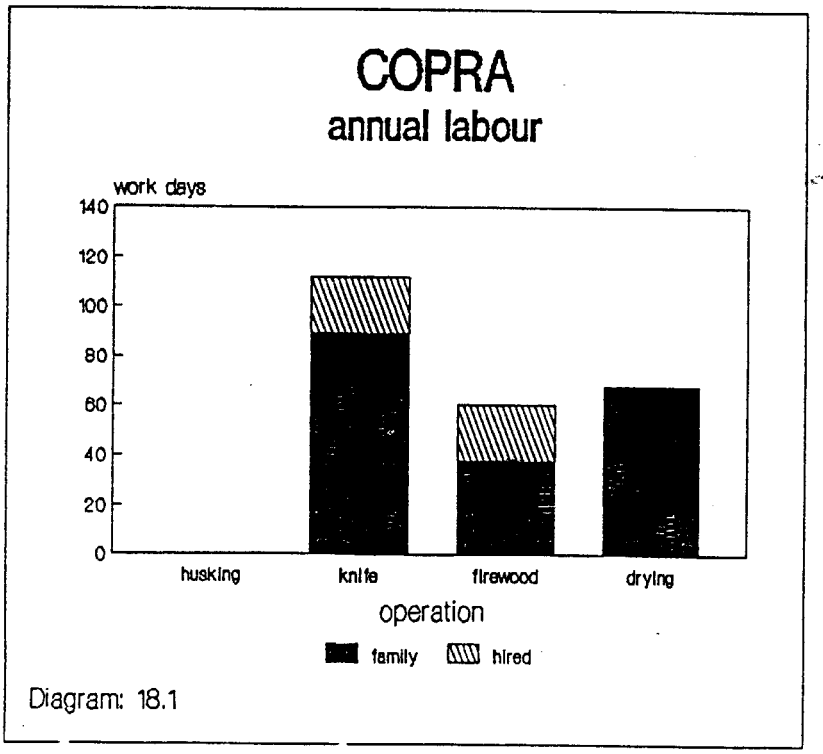


Diagram: 18.1

Table: 18.1
ANNUAL COPRA PRODUCTION AND LABOUR EXPENDITURE

Annual Labour Expenditure		family or shared labour		hired labour		total	% labour by operation
		work hours	work days	work days	cash cost ($.c)	work days	
HUSKING	picking, heaping						
	husking						
	transport						
	breaking						
	shelling						
	total						
COPRA KNIFE	picking, heaping	158.8	31.9	11.3	6.75	43.2	18
	axing + copra knife	205.2	31.4	7.5	4.50	38.9	16
	transport	37.7	25.9	3.8	2.25	29.7	12
	total	401.6	89.3	22.5	13.5	111.8	47
FIREWOOD	collection	40.0	5.0	7.5	5.00	12.5	5
	transport	42.0	5.3	7.5	4.50	12.8	5
	collection + transport	175.2	27.7	7.5	4.50	35.2	15
	total	257.2	37.9	22.5	14.0	60.4	25
DRYING	drying	174.6	31.4			31.4	13
	bagging	24.9	26.4			26.4	11
	transport	134.0	10.0			10.0	4
	total	333.4	67.9			67.9	28
TOTAL		992.2	195.1	45.0	27.5	240.1	100
% labour by type of labour			81	19		100	

copra grade	quantity of copra produced (kg)	
	per annum	per work day
Grade 1	1,306	5
Grade 2		
Grade 3		
Ungraded		
total	1,306	5

Number of observations = 4

18.4 The gross margin for copra production is summarised in table 18.2. From an annual production of **1,306kg** valued at the prevailing price of 33 cents per kilo the gross return is **SI$431.** Inputs costs from bags and twine amount to **SI$19.38** and labour costs are **SI$27.50.** The net income is **SI$348** which, at a requirement of **195** household labour days, represents a net return to labour of **SI$1.97** per household work day.

Table: 18.2
COPRA GROSS MARGIN

Annual production (kg)	1,306
Price per kilogram (SI$)	0.33
Gross return (SI$)	431
Inputs cost (SI$)	19.38
Labour cost (SI$)	27.50
Net return (SI$)	384
Household labour days	195
Copra production per household work day (kg)	6.70
Net return per household work day (SI$)	1.97

Inputs costs: Sacks @ SI$1.00 per new sack;
Average packed weight 70kg = 19 sacks = SI$19.00.
Twine @ SI$1.00 per hank of 50 strings = SI$0.38.

18.5 Table 18.3 presents the budget for cocoa processing, undertaken by only one sampled farmer, or 3% of sampled farmers.

Table: 18.3
ANNUAL COCOA PRODUCTION AND LABOUR EXPENDITURE

Annual Labour Expenditure		family or shared labour		hired labour		total	% labour by operation
		work hours	work days	work days	cash cost ($.c)	work days	
FIELD	harvesting	24.0	6.0			6.0	7
	breaking pod	12.0	6.0			6.0	7
	transport	6.0	3.0			3.0	4
	total	42.0	15.0			15.0	18
FIREWOOD	collection						
	transport						
	collection + transport						
	total						
DRYING	fermenting						
	drying	480.0	60.0			60.0	
	bagging	12.0	6.0			6.0	7
	transport	12.0	3.0			3.0	4
	total	504.0	69.0			69.0	82
TOTAL		546.0	84.0			84.0	100
% labour by type of labour			100			100	

cocoa	quantity of cocoa produced (kg)	
	per annum	per work day
Wet beans		
Dry Beans	105	1
total	105	1

Number of observations = 1

18.6 In total 84 work days were expended in the production of 105kg dry beans. All labour was from the household so there is no direct cash cost. Harvesting, breaking and field transport accounts for 18% of the labour requirement, while 82% is expended in drying, bagging and transporting to market. Labour expenditure in the production of cocoa is illustrated in diagram 18.2.

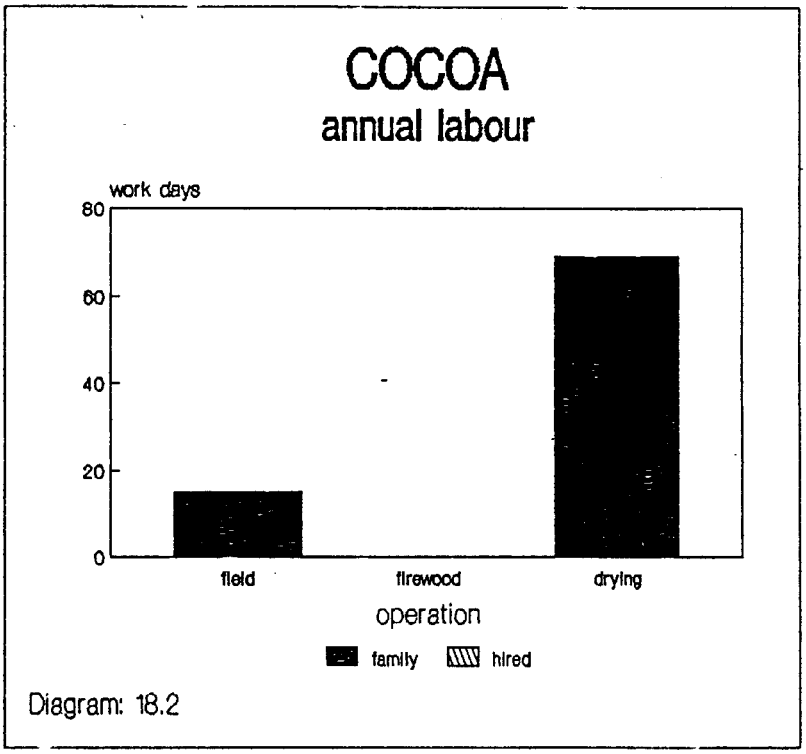


Diagram: 18.2

18.7 The gross margin for cocoa is shown in table 18.4. An annual production of 105kg of cocoa at the prevailing price of SI$1.80 per kilo provides a gross return of **SI$186**. Inputs costs amount to **SI$2.04**. There is no hired labour and so the net return is **SI$187**, representing a return to labour of **SI$2.23** per family day worked.

Table: 18.4
COCOA GROSS MARGIN

Annual production (kg)	105
Price per kilogram (SI$)	1.80
Gross return (SI$)	189
Inputs cost (SI$)	2.04
Labour cost (SI$)	0
Net return (SI$)	187
Household labour days	84
Cocoa production per household work day (kg)	1.25
Net return per household work day (SI$)	2.23

Inputs costs: Sacks @ SI$1.00 per new sack;
Average packed weight 65kg = 2 sacks = SI$2.00;
Twine @ SI$1.00 per hank of 50 strings = SI$0.04.

Chapter: 19
MARKETING

19.1 Table 19.1 presents a summary of marketing data collected in the survey, listing crops marketed against the number of observation recorded. The mean weight marketed is recorded, the time taken to go to market and back, the number of times the commodity is marketed per year, and the number of people involved in marketing. These are grouped under the heading of "marketing" details.

19.2 Marketing costs are recorded under the headings of freight or transport costs, fares for people involved in marketing, and market tax which may be imposed at the point of sale.

19.3 Revenues are possible where wages are earned, for instance from selling other farmers' produce and from the sale of crops. It is often difficult for sellers to specify costs and revenues, and in such cases data have to be treated as "missing". Thus the number of observations for crop sales may be lower than those for marketing data.

19.4 Table 19.2 is a transformation of the raw marketing data into an "average" annual marketing budget. The data are incomplete because of difficulties in recalling weights sold and marketing revenues. It is presented not as a model marketing budget, but as a data set to provide as much information on marketing as possible, albeit with gaps.

19.5 The two right-most columns show the net marketing revenue by crop and by household. The "net marketing revenue by crop" is the net return from sales after deducting costs. It is not the average income from crop sales since revenue may be negative where income data are missing or as a result of the double counting of transport costs when freight expenses are shared among several crops.

19.6 The "net marketing revenue per household" is the average household earnings taking account of the proportion of households selling each type of crop, but based on the limitations of the crop revenue data.

Table: 19.1
MARKETING TIME AND CROP PRICES

Basic Marketing Data:

		(---------- marketing ----------)					(--------- costs ---------)			(-- revenues --)		
		number of obs	mean weight marketed	time to market and back	times marketed per year	number of people	freight/ transport cost	fares for people	market tax	wages earned	crop sale price	crop sale obs
		(obs)	(kg)	(days)	(times)	(people)	(SI$)	(SI$)	(SI$)	(SI$)	($/kg)	(obs)
ALL CROPS	Average	40	345	1.8	6	2	3.10	3.66			0.35	17
COCONUT	Coconut	3	36	1.0	9	2					0.08	1
	Copra	5	1164	5.4	2	1	19.00	20.20			0.33	5
COCOA	Dry Beans	1	60		4	2	12.00				1.80	1
ROOT CROPS	Sweet Potato	12	37	1.0	8	2	0.65	1.75			0.18	6
	Yam	1	2	1.0	3	3	2.00	0.90				
	Pana	2	2	1.0	3	3	1.15	1.45			0.16	1
	Cassava	2		1.0	7	3	1.50	7.50			0.20	1
BEANS	Beans	1		1.0		1						
CABBAGE	Cabbage	3	25	1.0	6	1						
VEGETABLE	Tomato	1		1.0	12	2	0.60	1.20				
FRUIT CROPS	Pineapple	4	38	1.0	6	2	0.08	0.50			0.50	1
	Banana	4	5	1.0	6	1	0.20	0.55			0.40	1
NUT TREES	Other Nut	1		10.0	3	2						
Number of households		40										

Table: 19.2
INCOME FROM MARKETING

Annual Marketing Budget:

					⟨---------- costs (SI$) ----------⟩				⟨--- revenues (SI$) ---⟩				
		% houses marketing crop (%)	weight marketed (kg)	work days (days)	freight/ transport cost (SI$)	fares for people (SI$)	market tax (SI$)	total marketing costs (SI$)	wages earned (SI$)	crop sales ($/kg)	total revenue (SI$)	net marketing revenue by crop (SI$)	net marketing revenue per household (SI$)
ALL CROPS	Average		2026	17.0	18	21		39.66		700.64	700.64	661	116
COCONUT	Coconut	8	312	14.4						24.96	24.96	25	2
	Copra	13	2328	15.1	38	40		78.40		772.76	772.76	694	87
COCOA	Dry Beans	3	240		48			48.00		432.00	432.00	384	10
ROOT CROPS	Sweet Potato	30	281	12.1	5	13		18.40		50.60	50.60	32	10
	Yam	3	6	9.0	6	3		8.70				-9	0
	Pana	5	5	6.3	3	4		6.50		0.80	0.80	-6	0
	Cassava	5		21.0	11	53		63.00				-63	-3
BEANS	Beans	3											
CABBAGE	Cabbage	8	158	6.3									
VEGETABLE	Tomato	3		24.0	7	14		21.60				-22	-1
FRUIT CROPS	Pineapple	10	234	9.4	0	3		3.59		117.19	117.19	114	11
	Banana	10	28	6.9	1	3		4.13		11.00	11.00	7	1
NUT TREES	Other Nut	3		60.0									

19.7 Table 19.3 shows the time taken to different markets and the type of crop sold at each market. The classification of markets is open to a certain degree of interpretation, where "central" would generally be the provincial capital.

Table: 19.3
MARKET LOCATION

market location:		local	inter-mediate	central	Honiara	% obs	number of obs
i) Time taken to market produce							
time taken to go to market and back (days)		(% observations)					
0 - .5					3	3	1
.5 - 1		5	20	60		85	34
1 - 2							
2 - 5					3	3	1
5 - 10				3	8	10	4
› 10							
% observations		5	20	63	13	100	
number of observations		2	8	25	5		40
mean time (days)		1.00	1.00	1.36	5.20		1.75
ii) Crops sold at different markets		(% observations)					
COCONUT	coconut		5	3		8	3
	copra		3		10	13	5
COCOA	dry beans				3	3	1
ROOT CROPS	sweet potato	3	8	20		30	28
	yam			3		3	1
	pana			5		5	2
	cassava			5		5	2
BEANS	beans			3		3	3
CABBAGE	cabbage	3		5		8	3
VEGETABLE	tomato			3		3	1
FRUIT CROPS	pineapple		5	5		10	10
	banana			10		10	4
NUT TREES	unidentified			3		3	1
	% observations	5	20	63	13	100	
	number of observations	2	8	25	5		40

19.8 Table 19.4 summarises crop price perception and sale volumes.

Table: 19.4
CROP PRICE PERCEPTION AND SALE VOLUMES

		<---- sale price ---->			<----- sale volume ----->			number of obs
		poor	average	good	little	average	more than usual	
COCONUT	Coconut	33	67		33	67		3
	Copra	60	20	20	60	40		5
COCOA	Dry Beans	100			100			1
ROOT CROPS	Sweet Potato		50	50	33	67		12
	Yam		100			100		1
	Pana		50	50		100		2
	Cassava			100		100		2
BEANS	Beans			100		100		1
CABBAGE	Cabbage		33	67		100		3
VEGETABLE	Tomato			100		100		1
FRUIT CROPS	Pineapple		50	50		100		4
	Banana		25	75	25	75		4
NUT TREES	Other Nut			100			100	1
Number of observations		5	15	20	10	29	1	40

19.9 There is a general association between crop prices and sales, but many producers sell about "average" amounts irrespective of whether the price is felt to be good or not.

19.10 Table 19.5 summarises marketing problems. To the right of the table are the proportion of cases by severity of problem. These are combined with crop type in the body of the table to show the "index of severity". In this index "no problem" is weighted "0", "slight problem" is weighted "0.5", and "severe problem" is weighted "1.0". Thus if all cases registered a severe problem the index would be "1.0".

Table: 19.5
MARKETING PROBLEMS

Number of observations = 40

	⟨--- crop type ---⟩			⟨--- severity of problem ---⟩		
	coconut and cocoa	root crops	other crops	none	slight	severe
	(index of severity)			(% cases)		
terrain too difficult		0.0		95	5	
distance too great	0.1	0.2	0.1	48	28	25
not enough time/labour	0.0	0.1	0.1	78	20	3
transport cost too high	0.1	0.1	0.1	63	23	15
low price at market	0.1	0.1		65	25	10
lack of transport	0.1	0.2	0.1	55	33	13
unreliable transport	0.1	0.1	0.1	68	15	18
risk of not selling enough	0.0	0.1	0.0	78	20	3
crop damage in transit	0.1			90	5	5
administrative restrictions				100		
quarantine control				100		
other problem				100		

Note: "Index of Severity is a weighted summary of severity of marketing problems.
It falls in the range 0 to 1 where 0.0 = no marketing problem
0.5 = slight marketing problem
1.0 = severe marketing problem

19.11 Numerous problems are experienced, although few appear severe. About 20-30% of marketing problems are regarded as slight and around 10-20% are severe. Transport and distance are recurring problems, particularly in the sale of root crops.

Annex: 1
CROP NAMES AND CODES

A1.1 The following list describes the hierarchical coding sequence used by AES in farming systems surveys to describe crop types. The list may be added to by inserting other crops of interest within the appropriate category.

A1.2 At the garden level only broad distinctions are made between cleared land, tree crops, short term cash crops, and food crops. Only single digit numeric codes are permitted at this level and these do not distinguish between crop type or mixtures. They do, however, provide important information about the structure of the holding. Code "1" for instance specifies "tree crops".

A1.3 At the plot level alphabetical codes are used to describe crop mixtures. These are used to describe cropping patterns and the analysis of labour by crop. Letter codes are strung together so there is no pre-set limit on the complexity of mixtures described. Some simplification is introduced within the code categories themselves. The dominant crop is listed first and other crops are listed to the right in decreasing order of importance. The string code then takes the form of an alphabetical "number", where the most significant characters are to the left and the least significant to the right. Forinstance "a" specifies "cleared land", while "rvgfl" specifies a mixture in decreasing order of importance of "sweet potato, cassava, cabbage, beans, banana".

A1.4 At the yield and marketing levels it is necessary to specify exactly the crop under study, and so a unique three-digit numeric code is assigned to each crop. The list need not be complete and may be added to as necessary since "spare codes" are available. Forinstance "613" specifies "pineapple".

Table: A1.1
CROP NAMES AND CODES

garden		plot	yield and marketing		scientific name
code	name	code	code	name	
0	cleared	a	100	CLEARED (unplanted)	
1	tree crops	b	200	COCONUT	Cocos nucifera
			210	Local Tall	
			211	Rennel	
			212	Dwarf Hybrid	
			219	Other	
			250	Copra	
1	tree crops	c	300	COCOA	Theobroma cacao
			310	Cocoa green beans	
			311	Cocoa dry beans	
		d		Pasture	
3	food crops		400	ROOT CROPS	
		r	410	Sweet Potato	Ipomoea batatas
		s	411	Taro Common	Colocasia esculenta
		s	412	Giant	Alocasia micorhiza
		s	413	Hong Kong	Xanthosoma saggitifolium
		s	414	Swamp	Cytosperma chamissonis
		t	415	Yam	Dioscorea alata
		u	416	Pana	Dioscorea esculenta
		v	417	Cassava	Manihot esculenta
		w	419	Other root crop	
3	food crops	e	430	GRAIN CROPS	
			431	Corn	Zea mays
			432	Peanuts	Arachis hypogaea
			439	Other grain crop	
3	food crops	f	440	BEANS	
			441	Long bean	Phaseolus vulgaris
			442	Wing bean	Psophocarpus tetragonolobus
			443	Snake bean	Trichosanthes cucumerina
			444	Mung bean	Phaseolus aureus
			445	Pigeon pea	Cajanus cajan
			449	Other bean	

3	food crops	g	450	CABBAGE	
			451	Hibiscus cabbage	Hibiscus manihot
			452	Kangkong	
			453	Chinese cabbage	Brassica chinensis
			454	English cabbage	Brassica compestis
			455	Watercress	
			459	Other cabbage	
3	food crops	h	460	VEGETABLE	
			461	Pumpkin	Cucurbita maxima
			462	Cucumber	Cucumis sativus
			463	Shallot	Allium spp.
			464	Onion	Allium cepa
			465	Tomato	Lycopersicon esculentum
			466	Okra	Hibiscus esculentus
			467	Egg plant	Solanum melongena
			468	Green pepper (sweet)	Capsicum annuum
			479	Other vegetable	
2	short term cash crops	i	500	SPICES	
			511	Chilli pepper	Capsicum spp.
			512	Pepper corn	Piper nigrum
			513	Turmeric	Curcuma domestica
			514	Cardamom	Ellettaria cardamomum
			515	Cinnamon	Cinnamomum zeylanicum
			516	Ginger	Zingiber officinale
			517	Garlic	Allium sativum
			518	Vanilla	Vanilla fragrans
			529	Other spice	
2/3	cash/food crops	j	600	FRUIT CROPS	
			611	Water melon	Citrullus lanatus
			612	Rock melon	
			613	Pineapple	Ananas comosus
			614	Paw Paw	Carica papaya
			615	Passion fruit	Passiflora edulus f. flavicarpa
			619	Other fruit crop	
1	tree crops	k	620	FRUIT TREES	
			621	Guava	Psidium guajava
			622	Mango	Mangifera indica
			623	Soursop	
			624	Local Apple	
			625	Malayan Apple	Eugenia malaccensis
			626	Avocado	Persea americana
			629	Other fruit tree	

3	food crops	l	630	BANANA	Musa spp.
			631	Cooking banana	
			632	Sweet banana	
			639	Other banana	
1	tree crops	m	640	CITRUS TREES	
			641	Orange	Citrus sinensis
			642	Lime	Citrus aurantifolia
			643	Grapefruit	Citrus paradisi
			644	Pomelo	Citrus grandis
			649	Other citrus	
1	tree crops	n	650	NUT TREES	
			651	Ngali Nut	Canarium spp.
			652	Cut Nut	Barringtonia spp.
			653	Betel Nut	Areca catechu
			654	Cashew Nut	Anacardium occidentale
			655	Alite Nut	Terminalia catappa
			659	Other Nut	
2	short term cash crops	o	660	SUGAR CANE	
			661	Sugar cane	Saccharum spp.
			662	Pit Pit	Saccharum edule
			669	Other	
1	tree crops	p	700	FOOD/BUILDING TREE	
			701	Breadfruit	Artocarpus altilis
			702	Sago palm	Metroxylon spp.
			703	Bamboo	Nastus spp.
			709	Other tree	
2	short term cash crops	q	800	Tobacco	Nicotiana tabacum

Annex: 2
LABOUR BUDGETS

A2.1 Sunmmaries of labour in the main body of the report are derived from labour budgets shown in tables A2.1 to A2.9, each covering a major land or crop operation:

Table	Operation
A2.1	Land Clearance
A2.2	Cultivation
A2.3	Planting
A2.4	Tree Crops Establishment
A2.5	Tree Crops Maintenance
A2.6	First Weeding
A2.7	Second Weeding
A2.8	Third Weeding
A2.9	Harvesting

A2.2 Each table is divided into two sub-tables, named "a" and "b". Part "a" expresses budgets in the form of labour per hectare. Part "b" converts these results to labour per holding, based on mean holding sizes previously derived.

A2.3 Tables in "part a" are divided into two main components. Part "i" expresses "labour input by main crop growing in the plot". This is the measured labour input from field data and is derived from a subsample of plot observations. To the left of the table is the main crop type, which is the dominant crop in a mixture. In the first column of the table is the number of plots on which observations were made, and in the second column is the mean area of observed plots. The third column summarises the average number of times per year that the operation is performed in a cropping sequence, and the fourth column expresses the average number of hours worked per day.

A2.4 Within the box are labour data expressed in terms of seasonal (single crop) and annual (crop sequence) labour input, broken down by men, women and paid labour. The wage cost of paid labour is shown in the right-most column. In this, hours are converted to days by dividing by the average number of hours worked per day. This then takes account of "unproductive" time such as for travel to and from the garden, and expresses labour in terms of actual time taken. It does not, however, take account of different agricultural operations which may take place on the same day for instance where a morning might be spent clearing a plot while the afternoon is spent in weeding. Commonly work is split between the cool hours of the morning and late afternoon and so such circumstances should not generally arise.

A2.5 Below is "part ii" of the table, in which the composition of labour input is shown in more detail. The first four columns show the average number of workers in each category. Within the box is a summary of the table above, in which the % contribution of men, women and paid labour is shown.

A2.6 "Part b" of the table is on the page following "part a", in which annual labour per hectare is converted to annual labour per holding based on mean holding areas recorded for each given crop and operation - since each sub-sample will differ from the others. These are shown in the upper part of the table in two forms, as work hours and as work days by category of labour. The annual wage labour cost is shown in the far right column of the table.

A2.7 Below is the labour budget expressed in terms of time per household labour unit. In this it is assumed that communal labour is reciprocated and so balances out. Total labour input may therefore be expressed simply in terms of family labour. Wage labour is external and is therefore given the adult equivalent "weighting" of 1. Family labour is weighted according to the age composition of the family, analysed in chapter 3.

A2.8 Each set of tables for an operation is accompanied by a diagram in which the annual days of labour per holding are summarised by crop and by labour category.

A2.9 Various points should be noted about the derivation of labour budgets:

i) They are expressed in the form of "models" which are based on a sub-sample of observations. These are derived from interview, not direct measurement, although care is taken to minimise recall periods. Labour budgets are built up from a mosaic of labour records.

ii) Crop categories are summaries of complex mixtures in which the crop listed is dominant. Labour data are thus compatible with cropping pattern data and represents actual field conditions. No attempt is made to restrict or control the conditions under observation.

iii) Each table shows the labour input for an operation which is conducted. The tables do not show the extent to which operations may be missed or combined. Such refinements are difficult to include without a more complex, and therefore more costly and time consuming, survey design. The analysis therefore tends to be conservative since it does not take account of possible economies in combined operations.

iv) Caution should be exercised in interpreting results from few observations since labour data on complex systems are very variable.

v) Labour, although of central importance in the agricultural economy, is not necessarily economically optimising. Often labour has an important social character in which households will group together and "share" labour. Differences in site and labour composition, together with the social character of some labour, introduce considerable variability into results.

Table: A2.1a

LABOUR OPERATIONS ON LAND CLEARANCE (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: men (hours/ha)	labour input: women (hours/ha)	labour input: paid (hours/ha)	labour input: hours (hrs/ha)	labour input: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	91	0.334	1.31	6.1	380	331	18	954	157	10.19
Cleared land :	1	0.092	1.00	7.0	229	686		914	131	
Coconut :	15	1.400	0.80	5.1	366	314	3	547	108	4.17
Cocoa :	1	1.197	1.00	4.0	67	100		167	42	
Grain crops :	2	0.221	3.00	7.5		325	8	998	133	24.26
Cabbage :	1	0.049	1.00	8.0	488			488	61	
Fruit crops :	3	0.088	1.00	5.0	188	19	123	330	66	30.81
Tobacco :	1	0.005	1.00	5.0	1923			1923	385	
Sweet potato :	39	0.116	1.69	5.8	371	336	29	1247	215	16.62
Yam :	20	0.097	1.00	7.0	368	381	2	751	107	3.31
Pana :	7	0.126	1.00	7.1	487	380	5	872	122	10.48
Cassava :	1	0.038	1.00	7.0	560	560		1120	160	

	average number of workers: men	women	paid	total	% contribution: men	women	paid
ii) Labour composition							
All plots summary :	1.8	1.5	0.9	4.2	52	45	3
Cleared land :	1.0	3.0		4.0	25	75	
Coconut :	1.9	1.5	0.3	3.7	54	46	0
Cocoa :	2.0	3.0		5.0	40	60	
Grain crops :		4.0	1.5	5.5		98	2
Cabbage :	1.0			1.0	100		
Fruit crops :	0.7	0.3	6.7	7.7	57	6	37
Tobacco :	1.0			1.0	100		
Sweet potato :	1.9	1.3	1.3	4.5	50	46	4
Yam :	1.6	1.8	0.1	3.4	49	51	0
Pana :	3.7	1.7	0.1	5.6	56	44	1
Cassava :	1.0	1.0		2.0	50	50	

Note : 1. 'Operation times per year' is the average number of times the operation is performed per year.
2. 'Hours per year' is the sum of hours per season multiplied by times per year.

Table: A2.1b
LABOUR OPERATIONS ON LAND CLEARANCE (per holding)

i) Total time worked

	mean holding area (ha)	(work hours) men	women	paid	(work days) men	women	paid	total	labour cost (SI$)
Total :	1.169	404	368	13	75	67	2	144	8
Cleared land :	0.002	0	1		0	0		0	
Coconut :	0.818	240	206	2	47	41	0	88	3
Cocoa :	0.041	3	4		1	1		2	
Grain crops :	0.011		11	0		1	0	1	0
Cabbage :	0.001	0			0			0	
Fruit crops :	0.007	1	0	1	0	0	0	0	0
Tobacco :	0.000	0			0			0	
Sweet potato :	0.192	121	109	10	21	19	2	41	3
Yam :	0.063	23	24	0	3	3	0	7	0
Pana :	0.024	12	9	0	2	1	0	3	0
Cassava :	0.007	4	4		1	1		1	
Other	0.003								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	(work hours) men	women	paid	(work days) men	women	paid	% contribution to family labour men	women
Labour units available	2.03	2.63	1.00					
Total	199	140	13	37	26	1	52	48
Cleared land	0	1		0	0		25	75
Coconut	118	78	2	23	15	0	54	46
Cocoa	1	2		0	0		40	60
Grain crops		4	0		1	0		100
Cabbage	0			0			100	
Fruit crops	1	0	1	0	0	0	91	9
Tobacco	0			0			100	
Sweet potato	59	42	10	10	7	1	52	48
Yam	11	9	0	2	1	0	49	51
Pana	6	3	0	1	0	0	56	44
Cassava	2	1		0	0		50	50

Derived from household composition labour availability
% contribution to family labour is derived from the table above

Table: A2.2a
LABOUR OPERATIONS ON CULTIVATION (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: hours/ha: men	labour input: per season: hours/ha: women	labour input: per season: hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	79	0.145	1.43	5.7	337	133	6	680	119	6.95
Coconut :	5	0.431	1.00	5.4	355	214	5	574	106	10.83
Cocoa :	1	1.197	1.00	4.0	10			10	3	
Grain crops :	2	0.221	3.00	7.5		994		2983	398	
Cabbage :	1	0.049	1.00	4.0	81			81	20	
Fruit crops :	2	0.070	1.00	4.0		74	143	217	54	142.86
Tobacco :	1	0.005	1.00	4.0	1538			1538	385	
Sweet potato :	39	0.118	1.74	5.4	301	138	3	771	142	1.96
Yam :	20	0.097	1.05	6.2	346	79		446	73	
Pana :	7	0.126	1.00	6.6	624	48		672	102	
Cassava :	1	0.038	1.00	7.0	187			187	27	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary :	3.7	1.1	0.4	5.1	71	28	1
Coconut :	1.0	0.4	0.4	1.8	62	37	1
Cocoa :	3.0			3.0	100		
Grain crops :		4.0		4.0		100	
Cabbage :	1.0			1.0	100		
Fruit crops :		1.0	1.5	2.5		34	66
Tobacco :	1.0			1.0	100		
Sweet potato :	3.1	1.2	0.6	4.9	68	31	1
Yam :	4.7	1.0		5.7	81	19	
Pana :	9.9	0.6		10.4	93	7	
Cassava :	1.0			1.0	100		

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

Table: A2.2b

LABOUR OPERATIONS ON CULTIVATION (per holding)

i) Total time worked

	mean holding area (ha)	(work hours) men	(work hours) women	(work hours) paid	(work days) men	(work days) women	(work days) paid	(work days) total	labour cost (SI$)
Total :	1.169	431	261	7	79	46	1	126	10
Coconut :	0.818	290	175	4	54	32	1	87	9
Cocoa :	0.041	0			0			0	
Grain crops :	0.011		33			4		4	
Cabbage :	0.001	0			0			0	
Fruit crops :	0.007		1	1		0	0	0	1
Tobacco :	0.000	0			0			0	
Sweet potato :	0.192	101	46	1	19	9	0	27	0
Yam :	0.063	23	5		4	1		5	
Pana :	0.024	15	1		2	0		2	
Cassava :	0.007	1			0			0	
Other	0.005								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	(work hours) men	(work hours) women	(work hours) paid	(work days) men	(work days) women	(work days) paid	% contribution to family labour men	% contribution to family labour women
Labour units available	2.03	2.63	1.00					
Total	212	99	7	39	18	0	62	38
Coconut	143	66	4	26	12	0	62	38
Cocoa	0			0			100	
Grain crops		12			2			100
Cabbage	0			0			100	
Fruit crops		0	1		0	0		100
Tobacco	0			0			100	
Sweet potato	50	18	1	9	3	0	69	31
Yam	11	2		2	0		81	19
Pana	7	0		1	0		93	7
Cassava	1			0			100	

Derived from household composition labour availability

% contribution to family labour is derived from the table above

Table: A2.3a

LABOUR OPERATIONS ON PLANTING (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: hours/ha: men	labour input: per season: hours/ha: women	labour input: per season: hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	87	0.302	1.40	5.6	74	233	4	437	77	0.48
Coconut :	12	1.405	1.00	6.4	301	80		380	59	1.67
Cocoa :	1	1.197	1.00	4.0	20			20	5	3.00
Grain crops :	2	0.221	3.00	6.0		358		1073	179	
Cabbage :	1	0.049	1.00	4.0	81			81	20	1.00
Fruit crops :	3	0.088	1.00	3.7	19	43	95	157	43	0.33
Tobacco :	1	0.005	1.00	5.0	1923			1923	385	1.00
Sweet potato :	39	0.118	1.74	5.4	2	251	2	446	83	0.04
Yam :	20	0.097	1.10	6.0	34	297		364	61	0.17
Pana :	7	0.126	1.00	6.0		366		366	61	
Cassava :	1	0.038	1.00	7.0		187		187	27	

	average number of workers: men	women	paid	total	% contribution: men	women	paid
ii) Labour composition							
All plots summary :	0.3	2.7	0.1	3.1	24	75	1
Coconut :	1.7	0.7		2.3	79	21	
Cocoa :	3.0			3.0	100		
Grain crops :		2.5		2.5		100	
Cabbage :	1.0			1.0	100		
Fruit crops :	0.3	1.0	1.0	2.3	12	28	61
Tobacco :	1.0			1.0	100		
Sweet potato :	0.0	2.5	0.2	2.7	1	98	1
Yam :	0.2	4.0		4.1	10	90	
Pana :		5.4		5.4		100	
Cassava :		1.0		1.0		100	

Note : 1. 'Operation times per year' is the average number of times the operation is performed per year.
2. 'Hours per year' is the sum of hours per season multiplied by times per year.

Table: A2.3b

LABOUR OPERATIONS ON PLANTING (per holding)

i) Total time worked

	mean holding area (ha)	(------ work hours -----) men	women	paid	(--------- work days ---------) men	women	paid	total	labour cost (SI$)
Total :	1.169	250	192	1	39	33	0	72	2
Coconut :	0.818	246	65		38	10		48	1
Cocoa :	0.041	1			0			0	0
Grain crops :	0.011		12			2		2	
Cabbage :	0.001	0			0			0	0
Fruit crops :	0.007	0	0	1	0	0	0	0	0
Tobacco :	0.000	0			0			0	0
Sweet potato :	0.192	1	84	1	0	16	0	16	0
Yam :	0.063	2	21		0	3		4	0
Pana :	0.024		9			1		1	
Cassava :	0.007		1			0		0	
Other	0.005								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	(------ work hours -----) men	women	paid	(----- work days -----) men	women	paid	% contribution to family labour men	women
Labour units available	2.03	2.63	1.00					
Total	123	73	1	19	13	0	57	43
Coconut	121	25		19	4		79	21
Cocoa	0			0			100	
Grain crops		4			1			100
Cabbage	0			0			100	
Fruit crops	0	0	1	0	0	0	30	70
Tobacco	0			0			100	
Sweet potato	0	32	1	0	6	0	1	99
Yam	1	8		0	1		10	90
Pana		3			1			100
Cassava		0			0			100

Derived from household composition labour availability

% contribution to family labour is derived from the table above

Table: A2.4a
LABOUR OPERATIONS ON TREE CROPS ESTABLISHMENT (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: men (hours/ha)	labour input: women (hours/ha)	labour input: paid (hrs/ha)	labour input: hours per year (hours)	labour input: days per year (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	2	1.483	3.500	7.50	73	268		1196	159	
Coconut :	2	1.483	3.50	7.50	73	268		1196	159	

	average number of workers: men	women	paid	total	% contribution: men	women	paid
ii) Labour composition							
All plots summary :	1.0	2.0		3.0	21	79	
Coconut :	1.0	2.0		3.0	21	79	

Note : 1. 'Operation times per year' is the average number of times the operation is performed per year.
2. 'Hours per year' is the sum of hours per season multiplied by times per year.

Table: A2.4b

LABOUR OPERATIONS ON TREE CROPS ESTABLISHMENT (per holding)

i) Total time worked

	mean holding area (ha)	(work hours) men	(work hours) women	(work hours) paid	(work days) men	(work days) women	(work days) paid	(work days) total	labour cost (SI$)
Total :	1.169	210	768		28	102		130	
Coconut :	0.818	210	768		28	102		130	
Other	0.351								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	(work hours) men	(work hours) women	(work hours) paid	(work days) men	(work days) women	(work days) paid	% contribution to family labour men	% contribution to family labour women
Labour units available	2.03	2.63	1.00					
Total	104	292		14	39		21	79
Coconut	104	292		14	39		21	79

Derived from household composition labour availability

% contribution to family labour is derived from the table above

Table: A2.5a

LABOUR OPERATIONS ON TREE CROPS MAINTENANCE (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: men (hours/ha per season)	labour input: women (hours/ha per season)	labour input: paid (hours/ha per season)	labour input: hours (per year)	labour input: days (per year)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	2	1.155	3.50	2.50	5	10	29	153	61	60.00
Coconut :	2	1.155	3.50	2.50	5	10	29	153	61	60.00

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary :	0.5	1.0	2.5	4.0	11	23	66
Coconut :	0.5	1.0	2.5	4.0	11	23	66

Note : 1. 'Operation times per year' is the average number of times the operation is performed per year.
2. 'Hours per year' is the sum of hours per season multiplied by times per year.

Table: A2.5b

LABOUR OPERATIONS ON TREE CROPS MAINTENANCE (per holding)

i) Total time worked

		mean holding area (ha)	(work hours) men	women	paid	(work days) men	women	paid	total	labour cost (SI$)
Total	:	1.169	14	29	82	6	11	33	50	49
Coconut	:	0.818	14	29	82	6	11	33	50	49
Other		0.351								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	(work hours) men	women	paid	(work days) men	women	paid	% contribution to family labour men	women
Labour units available	2.03	2.63	1.00					
Total	7	11	82	3	4	12	33	67
Coconut	7	11	82	3	4	12	33	67

Derived from household composition labour availability

% contribution to family labour is derived from the table above

Table: A2.6a

LABOUR OPERATIONS ON FIRST WEEDING (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: hours/ha: men	labour input: per season: hours/ha: women	labour input: per season: hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	63	0.376	1.67	5.4	38	374	6	697	129	3.72
Coconut :	12	1.405	1.25	3.8	101	64	32	245	65	19.51
Cocoa :	1	1.197	1.00	4.0	67	53		120	30	
Grain crops :	2	0.221	3.00	6.0		114		342	57	
Cabbage :	1	0.049	1.00	4.0	244			244	61	
Fruit crops :	1	0.032	1.00	8.0	254			254	32	
Banana :	1	0.082	4.00	7.0	86	86		685	98	
Sweet potato :	34	0.119	1.88	5.6	10	524		1006	180	
Yam :	11	0.091	1.18	6.5	16	420		516	80	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary :	0.4	1.9	0.9	3.2	9	90	1
Coconut :	1.2	0.4	4.7	6.3	51	32	16
Cocoa :	4.0	4.0		8.0	56	44	
Grain crops :		2.5		2.5		100	
Cabbage :	1.0			1.0	100		
Fruit crops :	1.0			1.0	100		
Banana :	1.0	1.0		2.0	50	50	
Sweet potato :	0.1	2.2		2.3	2	98	
Yam :	0.2	2.7		2.9	4	96	

Note : 1. 'Operation times per year' is the average number of times the operation is performed per year.
2. 'Hours per year' is the sum of hours per season multiplied by times per year.

Table: A2.6b

LABOUR OPERATIONS ON FIRST WEEDING (per holding)

i) Total time worked

	mean holding area (ha)	(work hours) men	women	paid	(work days) men	women	paid	total	labour cost (SI$)
Total	1.169	113	292	33	29	57	9	95	16
Coconut	0.818	103	65	33	27	17	9	53	16
Cocoa	0.041	3	2		1	1		1	
Grain crops	0.011		4			1		1	
Cabbage	0.001	0			0			0	
Fruit crops	0.007	2			0			0	
Banana	0.002	1	1		0	0		0	
Sweet potato	0.192	4	190		1	34		35	
Yam	0.063	1	31		0	5		5	
Other	0.034								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	(work hours) men	women	paid	(work days) men	women	paid	% contribution to family labour men	women
Labour units available	2.03	2.63	1.00					
Total	56	111	33	14	22	3	28	72
Coconut	51	25	33	14	7	3	61	39
Cocoa	1	1		0	0		56	44
Grain crops		1			0			100
Cabbage	0			0			100	
Fruit crops	1			0			100	
Banana	0	0		0	0		50	50
Sweet potato	2	72		0	13		2	98
Yam	1	12		0	2		4	96

Derived from household composition labour availability

% contribution to family labour is derived from the table above

Table: A2.7a

LABOUR OPERATIONS ON SECOND WEEDING (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: hours/ha: men	labour input: per season: hours/ha: women	labour input: per season: hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	27	0.648	1.630	4.8	57	165	3	367	77	3.29
Coconut :	10	1.473	1.00	3.8	110	68	8	186	49	5.44
Cocoa :	1	1.197	1.00	4.0	20	20		40	10	
Cabbage :	1	0.049	1.00	4.0	163			163	41	
Fruit crops :	1	0.032	1.00	8.0	254			254	32	
Sweet potato :	11	0.098	2.45	4.8		235		576	120	
Yam :	3	0.139	1.33	7.3		392		523	71	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary :	0.6	1.5	1.5	3.6	25	73	1
Coconut :	1.1	0.9	4.0	6.0	59	37	4
Cocoa :	3.0	3.0		6.0	50	50	
Cabbage :	1.0			1.0	100		
Fruit crops :	1.0			1.0	100		
Sweet potato :		1.8		1.8		100	
Yam :		2.7		2.7		100	

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

Table: A2.7b

LABOUR OPERATIONS ON SECOND WEEDING (per holding)

i) Total time worked

	mean holding area (ha)	work hours men	work hours women	work hours paid	work days men	work days women	work days paid	work days total	labour cost (SI$)
Total :	1.169	93	200	6	24	42	2	68	4
Coconut :	0.818	90	56	6	24	15	2	40	4
Cocoa :	0.041	1	1		0	0		0	
Cabbage :	0.001	0			0			0	
Fruit crops :	0.007	2			0			0	
Sweet potato :	0.192		111			23		23	
Yam :	0.063		33			4		4	
Other	0.047								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours men	work hours women	work hours paid	work days men	work days women	work days paid	% contribution to family labour men	% contribution to family labour women
Labour units available	2.03	2.63	1.00					
Total	46	76	6	12	16	1	32	68
Coconut	44	21	6	12	6	1	62	38
Cocoa	0	0		0	0		50	50
Cabbage	0			0			100	
Fruit crops	1			0			100	
Sweet potato		42			9			100
Yam		13			2			100

Derived from household composition labour availability

% contribution to family labour is derived from the table above

Table: A2.8a

LABOUR OPERATIONS ON THIRD WEEDING (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: hours/ha: men	labour input: per season: hours/ha: women	labour input: per season: hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	12	0.861	1.147	3.7	45	80	25	172	47	10.77
Coconut :	5	1.940	1.00	3.0	108	13	60	182	61	25.85
Sweet potato :	5	0.076	2.00	3.8		94		188	49	
Yam :	2	0.124	1.00	5.0		210		210	42	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary :	0.3	1.2	1.2	2.7	30	53	17
Coconut :	0.8	0.6	2.8	4.2	60	7	33
Sweet potato :		1.2		1.2		100	
Yam :		2.5		2.5		100	

Note : 1. 'Operation times per year' is the average number of times the operation is performed per year.
2. 'Hours per year' is the sum of hours per season multiplied by times per year.

Table: A2.8b
LABOUR OPERATIONS ON THIRD WEEDING (per holding)

i) Total time worked

	mean holding area (ha)	(work hours) men	women	paid	(work days) men	women	paid	total	labour cost (SI$)
Total :	1.169	89	60	49	30	16	16	62	21
Coconut :	0.818	89	11	49	30	4	16	50	21
Sweet potato :	0.192		36			9		9	
Yam :	0.063		13			3		3	
Other	0.096								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	(work hours) men	women	paid	(work days) men	women	paid	% contribution to family labour men	women
Labour units available	2.03	2.63	1.00					
Total	44	23	49	15	6	6	60	40
Coconut	44	4	49	15	1	6	89	11
Sweet potato		14			4			100
Yam		5			1			100

Derived from household composition labour availability
% contribution to family labour is derived from the table above

Table: A2.9a

LABOUR OPERATIONS ON HARVESTING (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: hours/ha: men	labour input: per season: hours/ha: women	labour input: per season: hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	30	0.466	2.73	2.9	49	351	0	1093	377	0.62
Coconut :	4	2.565	3.75	5.0	106	110	3	822	164	6.43
Cocoa :	1	1.197	3.00	4.0	13			40	10	
Grain crops :	1	0.371	3.00	8.0	86	216		906	113	
Cabbage :	1	0.049	1.00	2.0	488			488	244	
Fruit crops :	2	0.078	2.50	1.5	36	12		119	80	
Sweet potato :	19	0.085	2.79	2.4	3	472		1324	547	
Yam :	2	0.124	1.00	2.0	165	437		601	301	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary :	0.5	1.7	0.2	2.4	12	88	0
Coconut :	1.8	2.0	1.3	5.0	48	50	1
Cocoa :	2.0			2.0	100		
Grain crops :	2.0	5.0		7.0	29	71	
Cabbage :	1.0			1.0	100		
Fruit crops :	1.0	1.5		2.5	75	25	
Sweet potato :	0.1	1.7		1.7	1	99	
Yam :	0.5	2.0		2.5	27	73	

Note : 1. 'Operation times per year' is the average number of times the operation is performed per year.
2. 'Hours per year' is the sum of hours per season multiplied by times per year.

Table: A2.9b

LABOUR OPERATIONS ON HARVESTING (per holding)

i) Total time worked

	mean holding area (ha)	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	work days: total	labour cost (SI$)
Total :	1.169	342	626	9	72	187	2	261	5
Coconut :	0.818	325	339	9	65	68	2	135	5
Cocoa :	0.041	2			0			0	
Grain crops :	0.011	3	7		0	1		1	
Cabbage :	0.001	0			0			0	
Fruit crops :	0.007	1	0		0	0		1	
Sweet potato :	0.192	2	253		1	104		105	
Yam :	0.063	10	28		5	14		19	
Other	0.036								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	% contribution to family labour: men	% contribution to family labour: women
Labour units available	2.03	2.63	1.00					
Total	169	238	9	36	71	1	35	65
Coconut	160	129	9	32	26	1	49	51
Cocoa	1			0			100	
Grain crops	1	3		0	0		29	71
Cabbage	0			0			100	
Fruit crops	0	0		0	0		75	25
Sweet potato	1	96		0	40		1	99
Yam	5	10		3	5		27	73

Derived from household composition labour availability

% contribution to family labour is derived from the table above

LAND CLEARANCE
Annual Labour per Holding

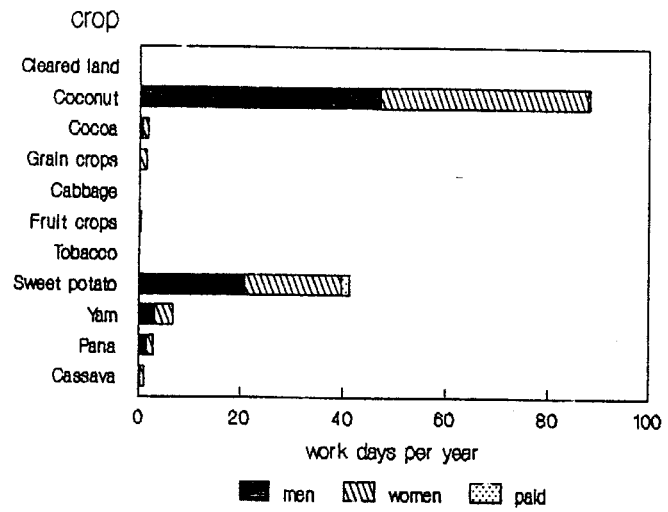


Diagram: A2.1

CULTIVATION
Annual Labour per Holding

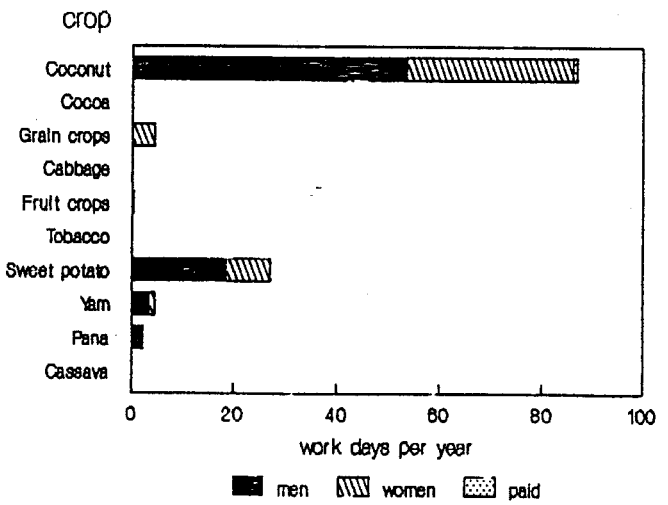
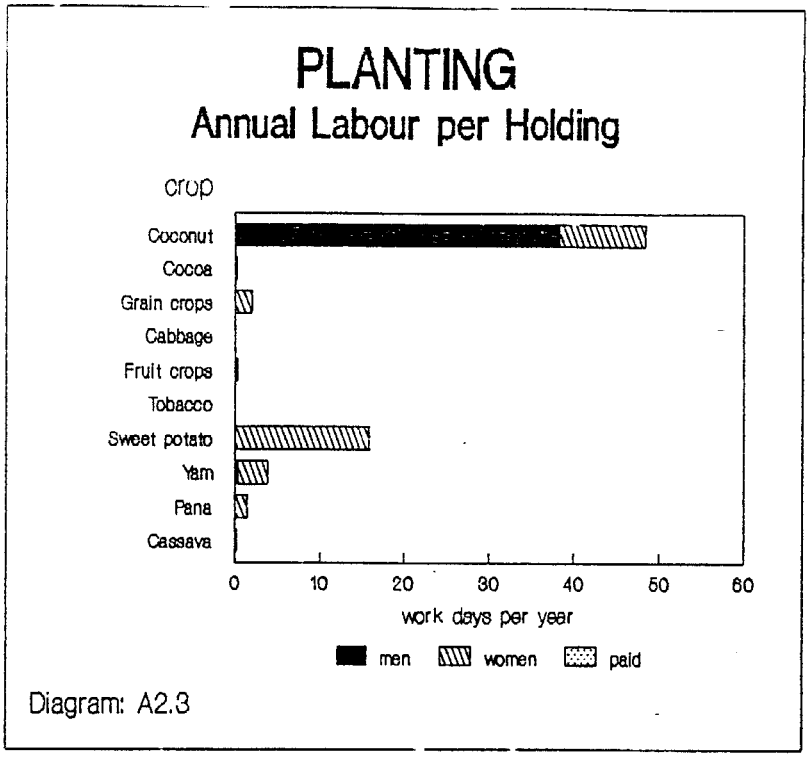


Diagram: A2.2



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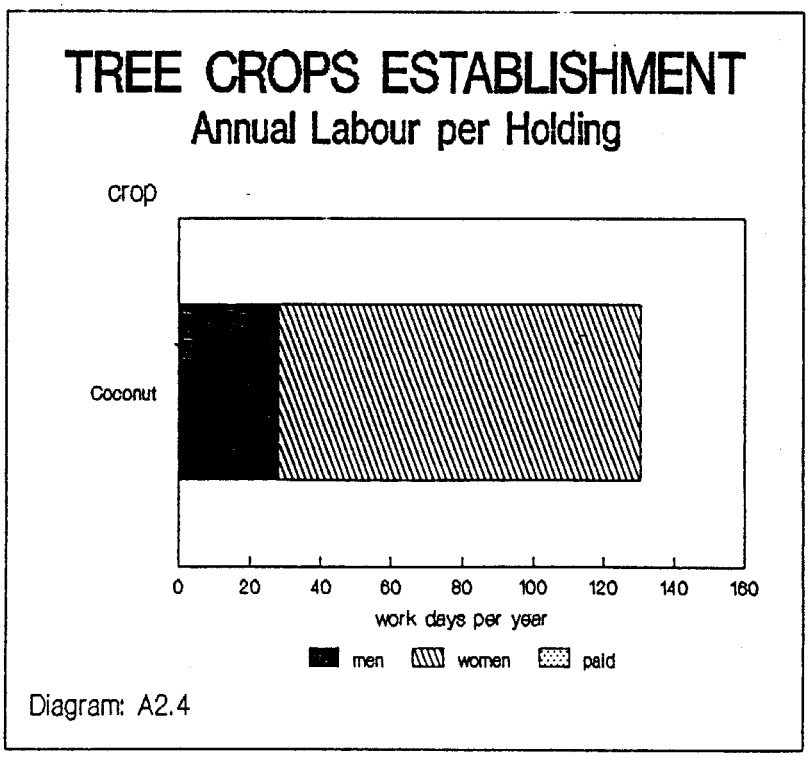

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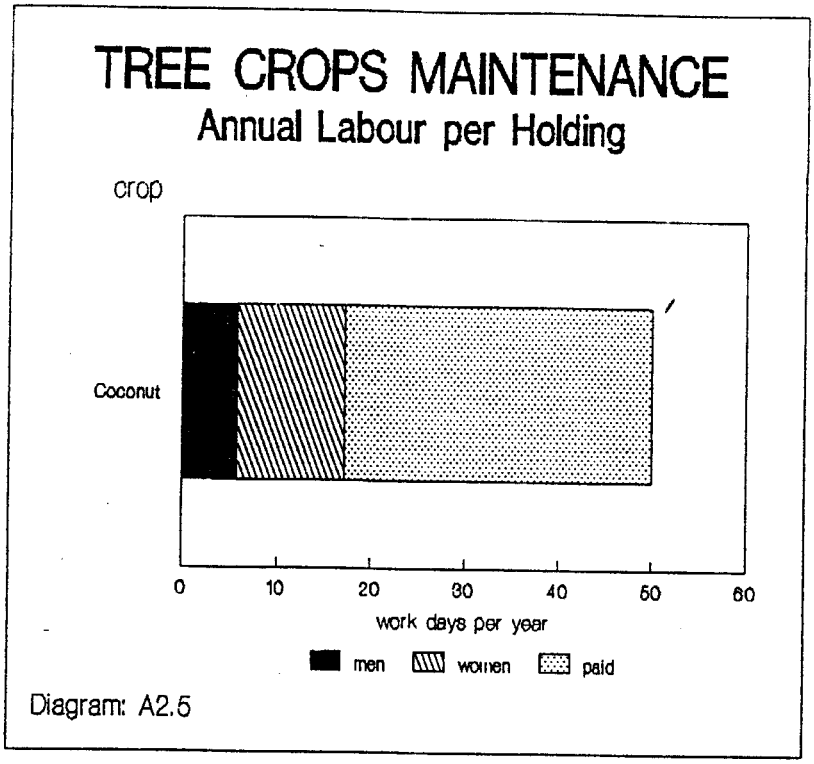

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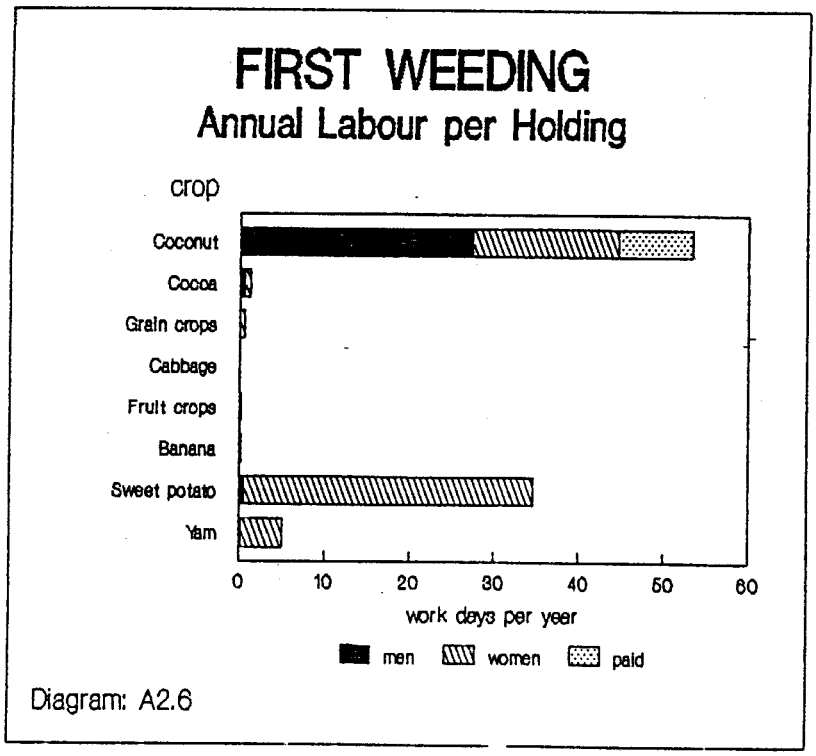

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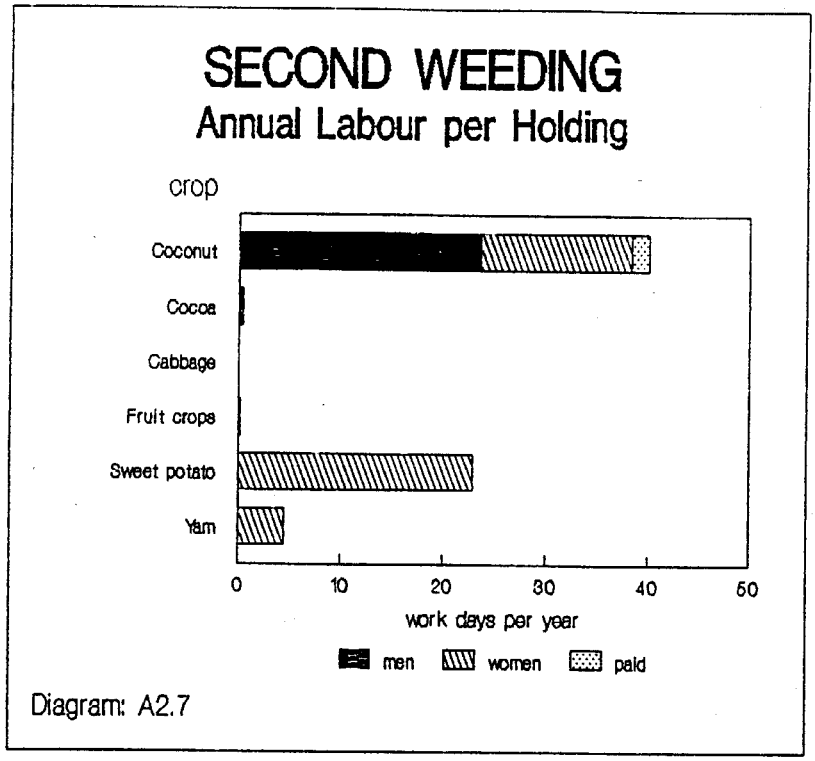

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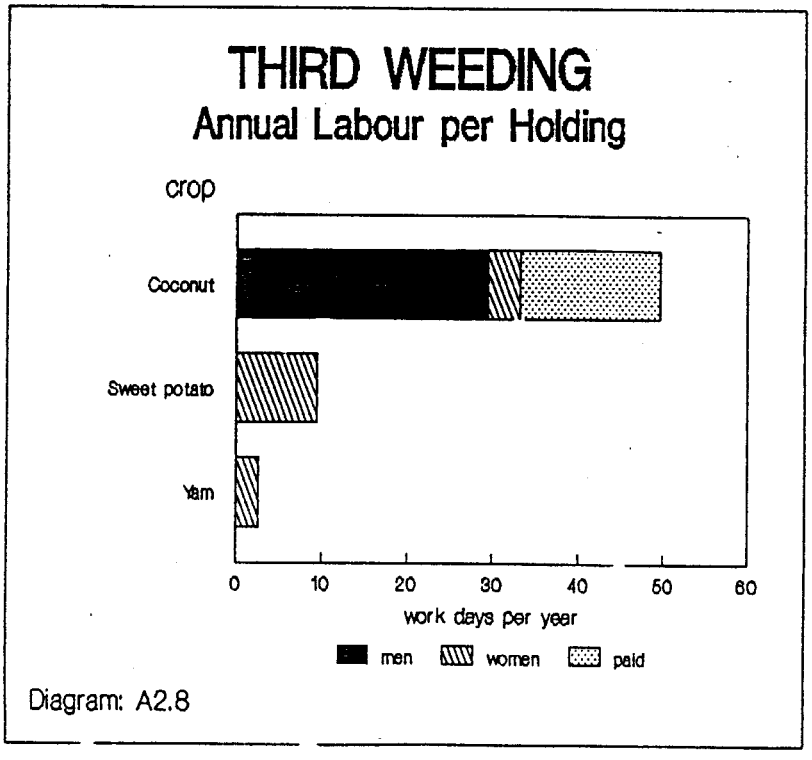

Diagram: A2.8

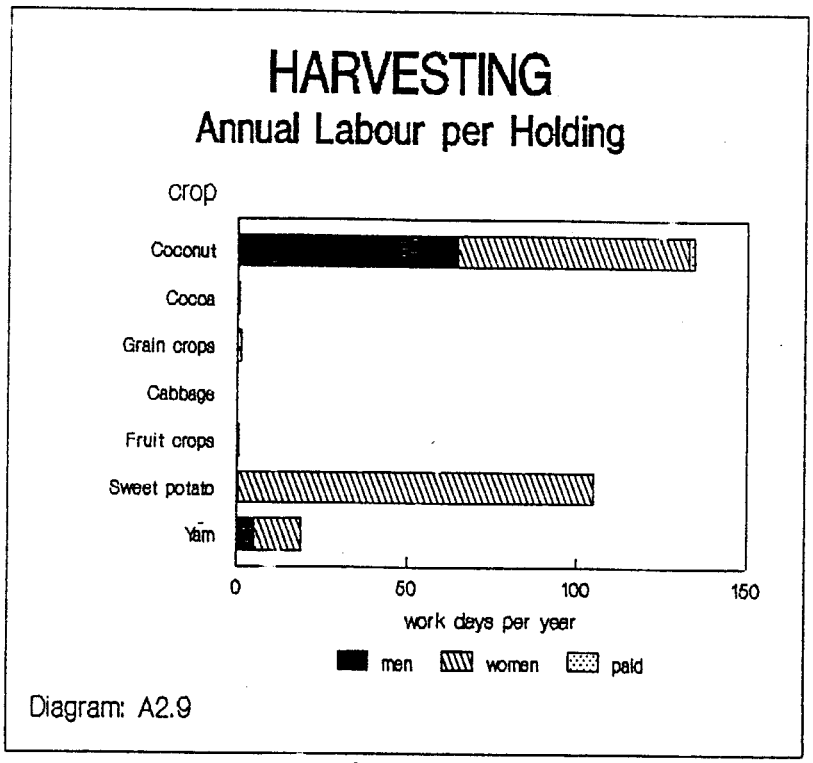
HARVESTING
Annual Labour per Holding
crop
Coconut
Cocoa
Grain crops
Cabbage
Fruit crops
Sweet potato
Yam
0
50
100
150
work days per year
men
women
paid

Diagram: A2.9

Annex: 3
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